

ENVIRONMENT MANAGEMENT PLAN

2020-21 Northern Territory Drilling Campaign

November 2020

Review record

Date	Reason for issue	Version	Author	Approver
24 July 2020	Submission to Department of Environment, Parks and Water Security (DEPWS)	CTP3-1	C. Lambert	D. Lockhart
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DISCLAIMER

This is a Central Petroleum Limited (CP) document and it has been prepared using the skill and care expected from professional scientists to provide factual and technical information and reasonable solutions to identified risks.

DOCUMENT OWNERSHIP AND REVISION

CP is the custodian of this Environmental Management Plan (EMP) and has overall responsibility for its implementation, compliance and revision.

CP will ensure that this EMP is reviewed and if necessary revised:

- When there is a significant change to normal operations for the activities covered by this EMP
- When there is a significant change to the regulatory framework within which the activities under this EMP are carried out
- When recommendations or comments from the Government approval process are made
- If there is a new environmental impact or environmental risk not provided for in the current plan for the activity or an increase, not provided for in the current plan for the activity
- In the event an incident causing significant environmental harm or loss occurs
- Five yearly after acceptance, unless superseded by another plan.

This document shall not be issued and/or revised without the express approval of the CP General Manager of Exploration (with respect to exploration activities under this EMP) and the Chief Operating Officer (with respect to development activities under this EMP).

DOCUMENT DETAILS

Document Number:	1000-630-PLN-0003-CTP3-4
Name of Document:	2020-21 Northern Territory Drilling Campaign: Environmental Management Plan
Authors:	Enviro-Value Pty Ltd. 
Client:	Central Petroleum
Name of Project:	2020-21 Northern Territory Drilling Campaign

Glossary	
AAPA	Aboriginal Areas Protection Authority
AEP	Annual Exceedance Probability
ALARP	As Low As Reasonably Practicable
APPEA	Australia Petroleum Production and Exploration Association
ARI	Average Recurrence Interval
BOP	Blow Out Preventer
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CCA	Cambrian Carbonate Aquifer
CD	Conservation Dependent
CE	Critically Endangered
CLC	Central Land Council
Competent person	Means a person who has the necessary ability, knowledge and the relevant experience to conduct the task or activity
CP	Central Petroleum Limited
CSA	Chemical Storage Area
DD	Data Deficient
DEPWS	Department of Environment, Parks and Water Security
DIPL	Department of Infrastructure, Planning and Logistics
DITT	Department of Industry, Tourism and Trade
DoEE	Department of the Environment and Energy
EC	Electrical Conductivity
ESCP	Erosion and Sediment Control Plan
DST	Drill Stem Test
EMP	Environment Management Plan
EMS	Environmental Management System
EN	Endangered
EP82	Exploration Permit 82
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESD	Ecologically Sustainable Development
EW	Extinct in the Wild
FIT	Formation Integrity Test
GDE	Groundwater Dependant Ecosystem
GIS	Geographic Information System
Ha	Hectare
HSE	Health, Safety and Environment
HSE MS	Health, Safety and Environmental Management System
LOT	Leak Off Test
Kg	Kilogram

Glossary	
L/s	Litres per second
L6	Production Licence 6
L7	Production Licence 7
m	Meter
mBGL	Metres Below Ground Level
mg/L	Milligrams per litre
mm	Millimetre
MCA	Multi Criteria Analysis
µS/cm	Microsiemen Per Centimetre
ML	Megalitre
MNES	Matters of National Environmental Significance
MDT	Modular Dynamic Test
NAFI	Northern Australia Fire Information
NORM	Naturally Occurring Radioactive Material
NT	Near Threatened
OCR	Onsite Company Representative
OL3	Operating Licence 3
OL4	Operating Licence 4
PAH	Polynuclear Aromatic Hydrocarbons
PMST	Protected Matters Search Tool
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
Significant Rainfall	Any rainfall event over 15 mm in 24 hours
SOBS	Site of Botanical Significance
SOCS	Site of Conservation Significance
SSCC	Sacred Sites Clearance Certificate
Suitably Qualified Person	A person who has the professional qualifications, training or skills or experience relevant to the nominated subject matter or task and can give authoritative assessment, advice and analysis about performance relevant to the subject matter using relevant protocols, standards, methods, literature or conduct tasks in accordance with requirements
TDS	Total Dissolved Solids
TRH	Total Residual Hydrocarbon
TPWC Act	Territory Parks and Wildlife Conservation Act
VU	Vulnerable
WoFS	Water observations From Space
WOMP	Well Operations Management Plan
WoNS	Weeds of National Significance

Executive Summary

CP is the operator of several petroleum titles within the Northern Territory (NT) under which it produces natural gas and oil. CP is proposing to undertake an exploratory and development drilling campaign across the titles listed in Table 0-1 and locations shown in Figure 0-1 to evaluate the potential of supplementing its existing oil and gas portfolio.

Table 0-1 Well Titles

Title	Field Name	# Wells	Well Type	Resource Target	Well Name
Production Licence 7	Dingo	2	Exploration*	Gas	Dingo-1 ST1 or Dingo-5
Exploration Permit 82	Orange	1	Exploration	Gas	Orange-3
Operating Licence 3	Palm Valley	1	Exploration*	Gas	Palm Valley-12
Operating Licence 4	Mereenie	2	Development	Gas	West Mereenie-27 and 28
Production Licence 6	Surprise	1	Exploration	Oil	Mamlambo-1

* These wells will be completed as a development well under this EMP if commercial quantities of gas are realised

The seven wells are located in geographically diverse areas of the Northern Territory, with all wells targeting formations within the Amadeus basin. No hydraulic stimulation of the wells is required during this drilling campaign.

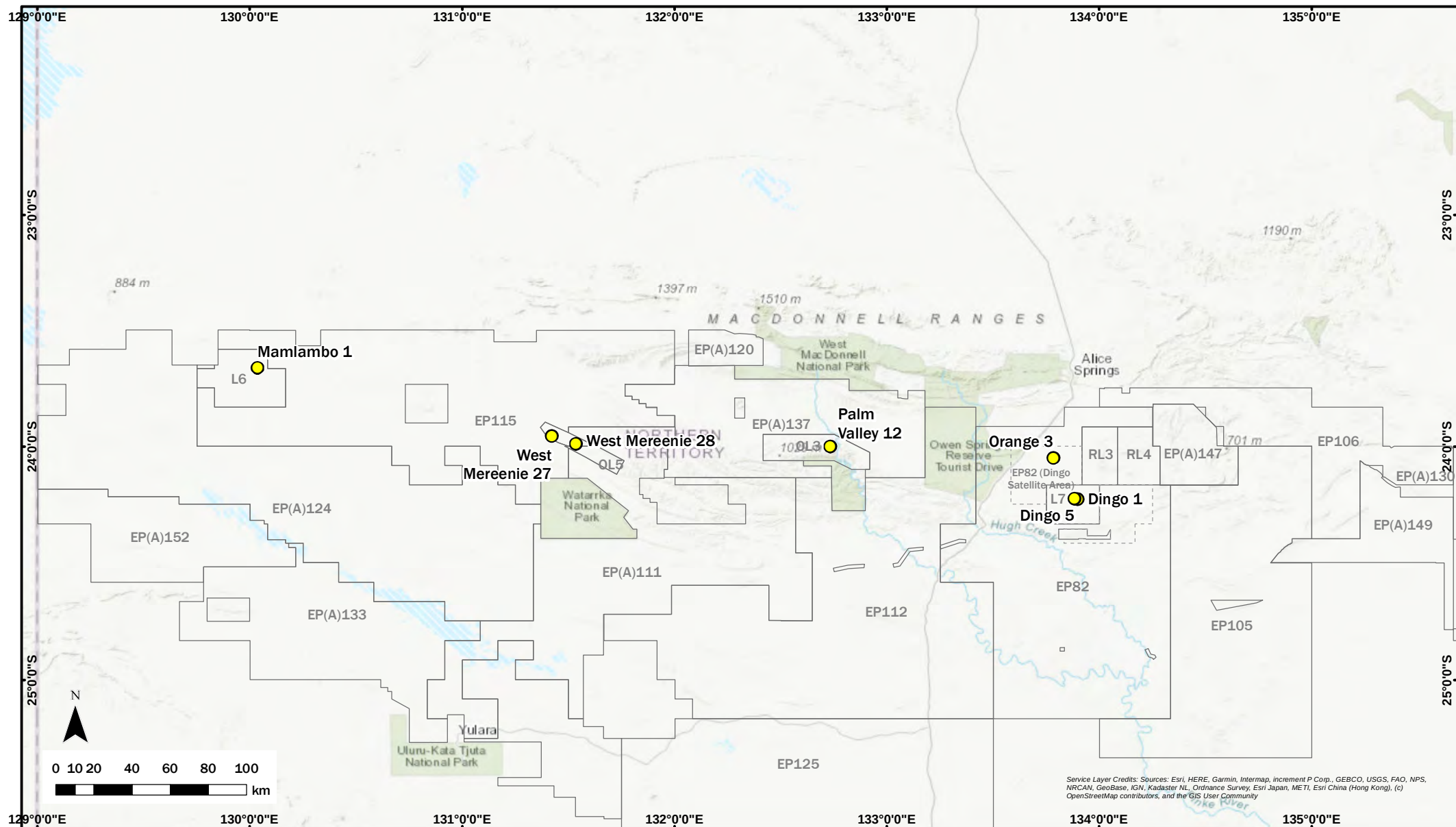
The purpose of this EMP is to demonstrate how CP will conduct its scope of activities in a manner consistent with the principles of ecologically sustainable development and such that impacts and risks are reduced to as low as reasonably practicable and acceptable levels.

Nominated Liaison

Details for CP's nominated liaison for this EMP are contained in Table 0-2 .

Table 0-2 Nominated Person Details

Attribute	Details
Name	Dr Duncan Lockhart
Position	General Manager Exploration
Company	Central Petroleum Limited
Address	7/369 Ann Street, Brisbane QLD 4000
Contact Details	Phone - +61 (0)7 3181 3800 E-mail - info@centralpetroleum.com.au



ID: 0505-103
 Rev:
 Date: 1/06/2020
 Map Scale is 1:2,716,742 when printed at A4
 Coordinate System: WGS 1984 Web Mercator Auxiliary

Figure 0-1: Drilling Campaign Locations

● Proposed well locations

□ CTP Permits



Description of the Activity

The environmental management plan covers the activities required to drill, test, complete, decommission and rehabilitate seven wells and includes the following:

- Construction of access tracks, well leases, vehicle turnarounds and temporary campsites
- Regrading of previously used temporary campsites
- Utilising a mixture of commercially supplied gravel and sand and/or extraction of gravel and sand from the wellsite (if available) to support construction activities
- Utilising a mixture of commercially supplied and existing groundwater bores for water requirements
- Installation and commissioning of above and below ground flowlines
- Drilling wells using a combination of air/mist and mud-based drilling systems
- Flaring of gas during drilling and well testing
- Onsite disposal of drill cutting, drill fluids and completion fluids in appropriately lined sumps where certified as acceptable by a third-party certifier
- Installation of wellsite production equipment and safety systems
- Completion of wells (excluding Orange-3 and Mamlambo-1 well)
- Decommissioning wells that are not completed
- Rehabilitation of wells that are decommissioned.

To enable refinement of proposed disturbance areas for the well leases, flowlines, access routes and camp as the campaign progresses, the baseline assessments and AAPA Authority Certificates have assessed a larger footprint than what is required for the campaign. The EMP seeks authorisation of these larger footprints (referred to as clearance areas) whilst limiting the amount of new ground disturbance within these clearance areas to that provided in Table 0-3 .

Table 0-3 Proposed Ground Disturbance Areas

Well Location	Survey Clearance Area (Ha)	Access disturbance area (Ha)	Flowline disturbance area (Ha)	Camp disturbance area (Ha)	Area (Ha)	Total Disturbance (Ha)	% of permit
Dingo 1ST	35			0.35	2.25	2.6	0.01%
Dingo 5	44	0.93			2.25	3.18	
Mamlambo 1	21.5	2.89			1.44	4.33	0.005%
Orange 3	38.5	1.44		0.35	2.25	4.04	0.0003%
PV 12	12	0.14	0.29		2.21	2.64	0.004%
WM 27	31	1.01	0.09		2.25	3.35	0.07%
WM 28	24	1.36	1.95		2.25	5.57	

Description of the Environment

A summary of the physical, natural and social environment for each of the well locations is provided in Table 0-4 to Table 0-8.

Table 0-4 Dingo Environment Summary

Attribute	Description
Climate	Arid to semi-arid.
Geology	Located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km ² and a maximum sediment thickness of 14,000 m.
Regional Soils	Mx25 - Alkaline and neutral red earths, with lesser areas of deep sands. AB59 - Chief soils are red earthy sands and red siliceous sands on the plains. BA27 - Chief soils are shallow stony sands.
Land Systems	Simpson - Spinifex-covered sand dunes. Dune fields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.
Land Types	The following six land types are present within the clearance area: ▪ Flat to gently undulating plains ▪ Sandy rises and dune flanks ▪ Flat red earth plains ▪ Low sand dunes / sand hills ▪ Gently sloping red earth sandplains ▪ Minor ephemeral drainage.
Groundwater	Six registered groundwater bores are located within 10 km of the proposed well locations – two are gas exploration wells and the remaining four were drilled into the Pertnara Formation. All four bores have either been backfilled or abandoned. Groundwater quality results from the nearest active bore to the wells (approximately 15 km) indicates that the groundwater is of poor potable quality.
Surface water	One major watercourse in the Dingo Gas field area is an unnamed ephemeral tributary of the Hugh River located approximately 20 km to the west of the Dingo well sites. Smaller drainage lines are mapped as being present approximately 10 km to the east of the Dingo wells. Flood modelling of the proposed Dingo-5 well lease indicates the well lease is not located within the 1% Annual Exceedance Probability rainfall event.
Bioregions	Finke

Attribute	Description
Site of conservation significance (SOCS) / Site of Biodiversity Significance (SOBS)	SOCS – Greater MacDonnell Ranges - approximately 30 km to the south-west of the Dingo wells SOBS – None present within clearance area
Conservation Significant Flora	None identified during baseline assessments of the clearance area. Twenty-eight Least Concern species under the Territory Parks and Wildlife Conservation Act were detected.
Conservation Significant Fauna	None identified during baseline assessments. Ten Least Concern species under the Territory Parks and Wildlife Conservation Act were detected.
Habitat	Spinifex sandplains, sandy red earth plains, low sand dunes, dune swales / red earth depressions and a minor drainage.
Weeds / Pests	Eighteen weed species have been recorded within 50 km of the Dingo wells. No declared or weeds of national significance located within the clearance area. Buffel grass, a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the clearance area. Fourteen pest species have been recorded within 50 km of the Dingo wells. Evidence of three species (camel, cat and cow) were detected during baseline assessments of the clearance area.
Fire History	Wider Dingo Gas Field has low fire frequency with three fires since 2000. The clearance area was last burnt in 2011.
Underlying Land Tenure / Use	Perpetual pastoral lease / cattle grazing.
Historical / Natural Heritage	None located with 50 km of the clearance area.
Aboriginal Sacred Sites	Baseline assessments confirmed that activities in the clearance area are unlikely to impact on aboriginal sacred sites. An authority certificate has been received from AAPA - C2020/031. A Sacred Site Clearance Certificate from the Central Land Council will also be obtained.

Table 0-5 West Mereenie Environment Summary

Attribute	Description
Climate	Arid to semi-arid
Geology	Located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km ² and a maximum sediment thickness of 14,000 m.

Attribute	Description
Regional Soils	AB31 - Chief soils are red earthy sands on the plains and swales. Red siliceous sands on the sand rises. Small areas of sandy red earths occur on the plains, in the swales and on the alluvial flats. AB62 - Chief soils are red earthy sands. BA28 - Chief soils are shallow stony sands.
Land Systems	Simpson - Spinifex-covered sand dunes. Dune fields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.
Land Types	The following eleven land types are present within the clearance area: ▪ Gently sloping red sandplains ▪ Sand dune and dune flanks ▪ Red earth plain in shallow broad depressions ▪ Sandy red earth plain ▪ Tussock grass sandy red earth plains and rises ▪ Spinifex red earth sandplains and sandy rises ▪ Red earth depression / swale ▪ Sandstone hill with a rocky breakaway area on the eastern side; transitions into a gravel plain to the west ▪ Gravelly (laterised) sandstone rise ▪ Spinifex sand dunes; low relief ▪ Sandy rise
Groundwater	The Mereenie Sandstone, Carmichael Sandstone and Pacoota Sandstone are known aquifers beneath the proposed West Mereenie wells. Eight registered and active groundwater bores are located within 5 km of the West Mereenie wells. All bores target the Mereenie Sandstone and historical monitoring shows water quality meets potable water requirements. Baseline assessments were conducted of the nearest bores and results were below drinking water and stock watering guidelines with no detection of hydrocarbon gases or products.

Attribute	Description
Surface water	No ephemeral streams are located in the vicinity of the proposed West Mereenie-27 well lease. The lack of drainage patterns in the area indicates that runoff seldom, if ever, occurs. A series of ephemeral streams are located approximately 1 km of the West Mereenie-28 well lease. These streams connect with Parke Creek which is approximately 7 km from the well lease. Flood modelling indicates that parts of the leases may experience inundation during the 1% Annual Exceedance Probability rainfall event. Mitigation measures in line with the Flood Modelling Report are to be undertaken by Central Petroleum Limited
Bioregions	Great Sandy Desert -West Mereenie-27 well MacDonnell Ranges – West Mereenie-28 well
SOCS / SOBS	SOCS – George Rill Range and Surrounds approximately 20 km to the south of the clearance areas SOBS – West Mereenie-27 well is located within the Laycock Sandplain SOBS and the West Mereenie-28 well is located within the Mereenie SOBS
Conservation Significant Flora	One hundred and forty Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Conservation Significant Fauna	None identified during baseline assessments. Eighteen Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Habitat	W27- Gently sloping red sandplain, low linear dune, Mulga-dominated red earth depressions and sandy red earth areas. W28- Sandy red earth plains and rises, a low sandstone hill
Weeds / Pests	Eight weed species have been recorded within 50 km of the West Mereenie wells. No declared or weeds of national significance located within the clearance area. Buffel grass, a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the clearance area. Nine pest species have been recorded within 50 km of the West Mereenie wells. Evidence of three species (horse, rabbit and cow) were detected during baseline assessments of the clearance area.
Fire History	Fire records indicate a very low frequency of fire with only one recorded fire since 2000 at the proposed West Mereenie-27 well site.
Underlying Land Tenure / Use	Aboriginal land
Historical Heritage	None located with 50 km of the clearance area

Attribute	Description
Aboriginal Sacred Sites	Baseline assessments confirmed presence of sites within the clearance area and are to be avoided. Application for an authority certificate has been lodged with AAPA (# 202000411). A Sacred Site Clearance Certificate from the Central Land Council will also be obtained.

Table 0-6 Orange-3 Environment Summary

Attribute	Description
Climate	Arid to semi-arid
Geology	Located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km ² and a maximum sediment thickness of 14,000 m.
Regional Soils	Mx25 – Alkaline and neutral red earths, with lesser areas of deep sands AB59 – Chief soils are red earthy sands and red siliceous sands on the plains Ld1 - Chief soils are calcareous earths
Land Systems	Ewaninga - Undulating sandy country with low sand dunes, sandplains and minor limestone hills. Quaternary aeolian sand and scattered outcrops of calcareous conglomerate and sandstone. Deep red sands and loamy limestone soils.
Land Types	The following six land types are present within the clearance area: ▪ Gently undulating calcareous plain ▪ Slightly elevated sandy areas ▪ Low calcrete rises ▪ Minor drainage ▪ Sandy hills and shortly aligned sand dunes ▪ Clay depression
Groundwater	The Mereenie Sandstone, Pacoota Sandstone, Goyder and Shannon Formations are all known aquifers that are below the Orange-3 well. There are seven registered bores within 10 km of the proposed Orange-3 well lease, however only one is still active. Baseline samples were taken from this bore and results indicated a quality that was below drinking water health related guidelines and stock watering guidelines. No detections of hydrocarbon gases or products were recorded.
Surface water	A series of unnamed ephemeral streams are located within 1 km of the proposed Orange-3 well lease which eventually connects to an unnamed tributary of the Hugh River. Flood modelling indicates that parts of the well lease are within the 1% Annual Exceedance Probability rainfall event and that mitigation measures as outlined in the Flood Modelling Report are required to be installed.

Attribute	Description
Bioregions	Finke
SOCS / SOBS	SOCS – Waterhouse Range approximately 20 km to the east. SOBS - None
Conservation Significant Flora	None identified during baseline assessments. Twenty-eight Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Conservation Significant Fauna	None identified during baseline assessments. Five Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Habitat	Undulating calcareous plains, calcrete rises, low sand dunes / sand hills and a minor poorly defined drainage
Weeds / Pests	Twenty-nine weed species have been recorded within 50 km of the Orange 3 well. No declared or weeds of national significance located within the clearance area. Buffel grass, a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the clearance area. Nineteen pest species have been recorded within 50 km of the Orange 3 wells. Evidence of two species (rabbit and cow) were detected during baseline assessments of the clearance area.
Fire History	Very low with only one fire recorded since 2000. Last fire occurred in 2011
Underlying Land Tenure / Use	Pastoral lease / Pastoral and nature reserve
Historical Heritage	None located with 50 km of the clearance area
Aboriginal Sacred Sites	Baseline assessments confirmed presence of sites within the clearance area and are to be avoided. An authority certificate has been received from AAPA – C2020/033 A Sacred Site Clearance Certificate from the Central Land Council will also be obtained.

Table 0-7 Palm Valley-12 Environment Summary

Attribute	Description
Climate	Arid to semi-arid
Geology	Located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km ² and a maximum sediment thickness of 14,000 m

Attribute	Description
Regional Soils	Mx25 – Alkaline and neutral red earths, with lesser areas of deep sands BA28 - Chief soils are shallow stony sands BB26 - Chief soils are shallow calcareous loams and sands Nc3 - Chief soils are crusty loamy soils, with lesser areas of deep sandy soils
Land Systems	Krichauff - Bold sandstone plateaux. Stony plateaux, tablelands & hills on sandstone, siltstone, quartzite & conglomerate (deeply weathered in places). Strongly superimposed drainages with narrow gorges and joint-controlled tributaries that can feed into riverine channels. Relief up to 200m. Outcrop with shallow stony soils.
Land Types	The following four land types are present within the clearance area: ▪ Undulating rocky plateau (north of access road) ▪ Undulating rocky plateau (south of access road) ▪ Steep rocky north facing gullies ▪ Steep rocky south facing gullies
Groundwater	The Hermannsburg Sandstone, Mereenie Sandstone, Carmichael Sandstone and Pacoota Sandstone are known aquifers that are below the Palm Valley-12 well. There are six registered and active groundwater bores located within 5 km of the Palm Valley-12 well. All bores target the Hermannsburg Sandstone and historical monitoring shows water quality meets potable water requirements. Baseline assessments were conducted of the nearest bores and results were below drinking water and stock watering guidelines with no detection of hydrocarbon gases or products.
Surface water	There are multiple drainage lines that join with the two major ephemeral creeks (Palm and Ellery) located within the wider Palm Valley Gas Field. Both these creeks eventually connect to the Finke River (which traverses through the eastern section of the gas field). Flood modelling indicates that the well lease is not located within the 1% Annual Exceedance Probability rainfall event.
Bioregions	MacDonnell Ranges
SOCS / SOBS	SOCS – Located within the Greater MacDonnell Ranges SOCS SOBS – Located within the Palm Valley SOBS
Conservation Significant Flora	Two Near Threatened species (<i>Eucalyptus lucens</i> and <i>Stenanthemum centrale</i>) under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments. Forty-six Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Conservation Significant Fauna	None identified during baseline assessments. Two Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Habitat	Sandstone plateaux and the 'head' of steep rocky sandstone gullies.

Attribute	Description
Weeds / Pests	Twelve weed species have been recorded within 50 km of the Palm Valley-12 well. No declared or weeds of national significance located within the clearance area. Buffel grass, a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the clearance area. Thirteen pest species have been recorded within 50 km of the Palm Valley-12 well. Evidence of two species (rabbit and cow) were detected during baseline assessments of the clearance area.
Fire History	Very low with only one fire event since 2000. Last fire occurred in 2002 as part of a controlled burn.
Underlying Land Tenure / Use	Aboriginal land
Historical Heritage	None located with 50 km of the clearance area
Aboriginal Sacred Sites	Baseline assessments confirmed presence of sites within the clearance area and will be obtaining a Works Approval under the <i>Heritage Act 2011</i>. An authority certificate has been received from AAPA – C2020/061 A Sacred Site Clearance Certificate from the Central Land Council will also be obtained.

Table 0-8 Mamlambo-1 Environment Summary

Attribute	Location Description
Climate	Arid to semi-arid
Geology	Located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km ² and a maximum sediment thickness of 14,000 m.
Regional Soils	AB56 - Chief soils are red earthy sands on interdune plains and red siliceous sands on dunes BA27 - Chief soils are shallow stony sands
Land Systems	Simpson - Spinifex-covered sand dunes. Dune fields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.

Attribute	Location Description
Land Types	The following six land types are present within the clearance area: ▪ Flat to gently undulating sandplain ▪ Sandy red earth depressions; flat; localised ▪ Low linear sand dunes ▪ Stand of Desert Oak within sandplain ▪ Low calcrete rise ▪ Calcareous earth
Groundwater	The Quaternary / Tertiary Sediments and Mereenie Sandstone are known aquifers that are below the Mamlambo-1 well. There are four registered bores within 10 km of the proposed Mamlambo-1 well that target either the Mereenie Sandstone or the Quaternary Sediments. Baseline samples were obtained for the Mereenie Sandstone and results indicated that water quality exceeded palatability criteria for total dissolved solids and health based drinking water guidelines for fluoride. The samples also detected total petroleum hydrocarbons and total residual hydrocarbons in the water.
Surface water	Located within an expansive floodplain which conveys flows through to Lake MacDonald during flood events. Flood modelling indicates the proposed well lease is not located within the 1% Annual Exceedance Probability rainfall event
Bioregions	Great Sandy Desert
SOCS / SOBS	SOCS – Cleland Hills and Surrounds are located approximately 40 km to the east SOBS - None
Conservation Significant Flora	One Data Deficient species (<i>Acacia incurvaneura</i>) under the Territory Parks and Wildlife Conservation Act was detected within the clearance area during baseline assessments. Ninety-three Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Conservation Significant Fauna	None identified during baseline assessments. Twenty-five Least Concern species under the Territory Parks and Wildlife Conservation Act were detected within the clearance area during baseline assessments.
Habitat	Sandy red earth plains and rises, a low sandstone hill
Weeds / Pests	Three weed species have been recorded within 50 km of the Mamlambo-1 well. No declared or weeds of national significance located within the clearance area. Buffel grass, a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the clearance area. Six pest species have been recorded within 50 km of the Mamlambo-1 well. Evidence of one species (camel) was detected during baseline assessments of the clearance area.

Attribute	Location Description
Fire History	Fire history within the wider Surprise Field is mixed with areas experiencing up to 5 fire events since 2000. The clearance area is located in an area where three fires have occurred since 2000, with the last fire occurring in 2011.
Underlying Land Tenure / Use	Aboriginal land
Historical Heritage	None located with 50 km of the clearance area
Aboriginal Sacred Sites	Baseline assessments confirmed presence of sites within the clearance area and are to be avoided. CP has obtained an Authority Certificate from the AAPA for the Mamlambo-1 well (Certificate # C2020/058). A Sacred Site Clearance Certificate from the Central Land Council will also be obtained.

Risk Assessment Summary

CP has undertaken a risk assessment that is consistent with the requirements of International Standards Organisation 31000 for the activities under this EMP. The risk assessment has considered the inherent risk of an activity (i.e. without controls in place) and the residual risk (i.e. after mitigation measures have been applied).

For residual risks that have a risk score of 'Low' these are considered as low as reasonably practicable and acceptable. For residual risks that have a risk score that is not 'Low' the risk assessments have included discussions on whether these are as low as reasonably practicable and acceptable.

Table 0-9 provides a summary of the residual risks for activities under the EMP. All risks are considered to be as low as reasonably practicable and acceptable.

Table 0-9 Residual Risk Summary

Residual Risk				
Risk Level	Low	Medium	High	Very High
Count	34	10	0	0

The 'Medium' residual risks for activities under this environmental management plan are:

- Decline in aquifer water levels due to cross-flow of groundwater to another formation
- Local contamination of utilised aquifer leading to impaired capacity of water bores
- Contamination of aquifers impacts existing groundwater users and environmental dependencies
- Loss in long term soil productivity and viability
- Increase in air pollutants in areas surrounding drilling activities
- Significant decrease in population of conservation significant flora / fauna habitat (from three different causes)
- Reduction in native fauna species
- Unauthorised disturbance to sacred sites or culturally sensitive sites
- Reduction in productivity of the land
- Greenhouse gas emissions from the activity.

Management Plans

Management plans have been developed for the following:

- Erosion and Sediment Control
- Weed Management
- Bushfire Management
- Wastewater Management
- Spill Management
- Methane Emission Management
- Rehabilitation Management
- Emergency Response.

Stakeholder Engagement

Initial engagement with defined stakeholders as per the definition in the Petroleum (Environment) Regulations 2016 for the drilling program was undertaken during November 2019. Stakeholders who were present during this consultation included the Central Land Council, landowners, lease holders and members of the community. In addition, further engagement has been carried out with the directly affected stakeholders to provide further information about the project and this EMP.

Under the Sacred Sites Clearance Certificate and various agreements, Liaison Committee Meetings are the formal method by which the Central Land Council is to be engaged. Formal Liaison Committee Meetings were scheduled for March 2020, however to date, the meetings as well as landholder meetings have been postponed on multiple occasions due to the restrictions introduced as a result of the covid-19 pandemic.

CP will be engaging with landholders directly as well attending the next round of Liaison Committee Meetings (organised by the Central Land Council) which are due to be held in September 2020 to provide a further information on the program including the information required under the Petroleum (Environment) Regulations 2016.

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1.0 Introduction

1.1 Background

Central Petroleum Limited (CP) is the operator of several petroleum titles within the Northern Territory under which it produces natural gas and oil. CP is proposing to undertake an exploratory and development drilling campaign across the titles listed in Table 1-1 and locations shown in Figure 1-1 to evaluate the potential of supplementing its existing oil and gas portfolio.

Table 1-1 Well Titles

Title	Field Name	# Wells	Well Type	Resource Target	Well Name
Production Licence 7 (L7)	Dingo	2	Exploration*	Gas	Dingo-1 ST1 or Dingo-5
Exploration Permit 82 (EP82)	Orange	1	Exploration	Gas	Orange-3
Operating Licence 3 (OL3)	Palm Valley	1	Exploration*	Gas	Palm Valley-12 (PV12)
Operating Licence 4 (OL4)	Mereenie	2	Development	Gas	West Mereenie-27 (MW27) and West Mereenie-28 (MW28)
Production Licence 6 (L6)	Surprise	1	Exploration	Oil	Mamlambo-1

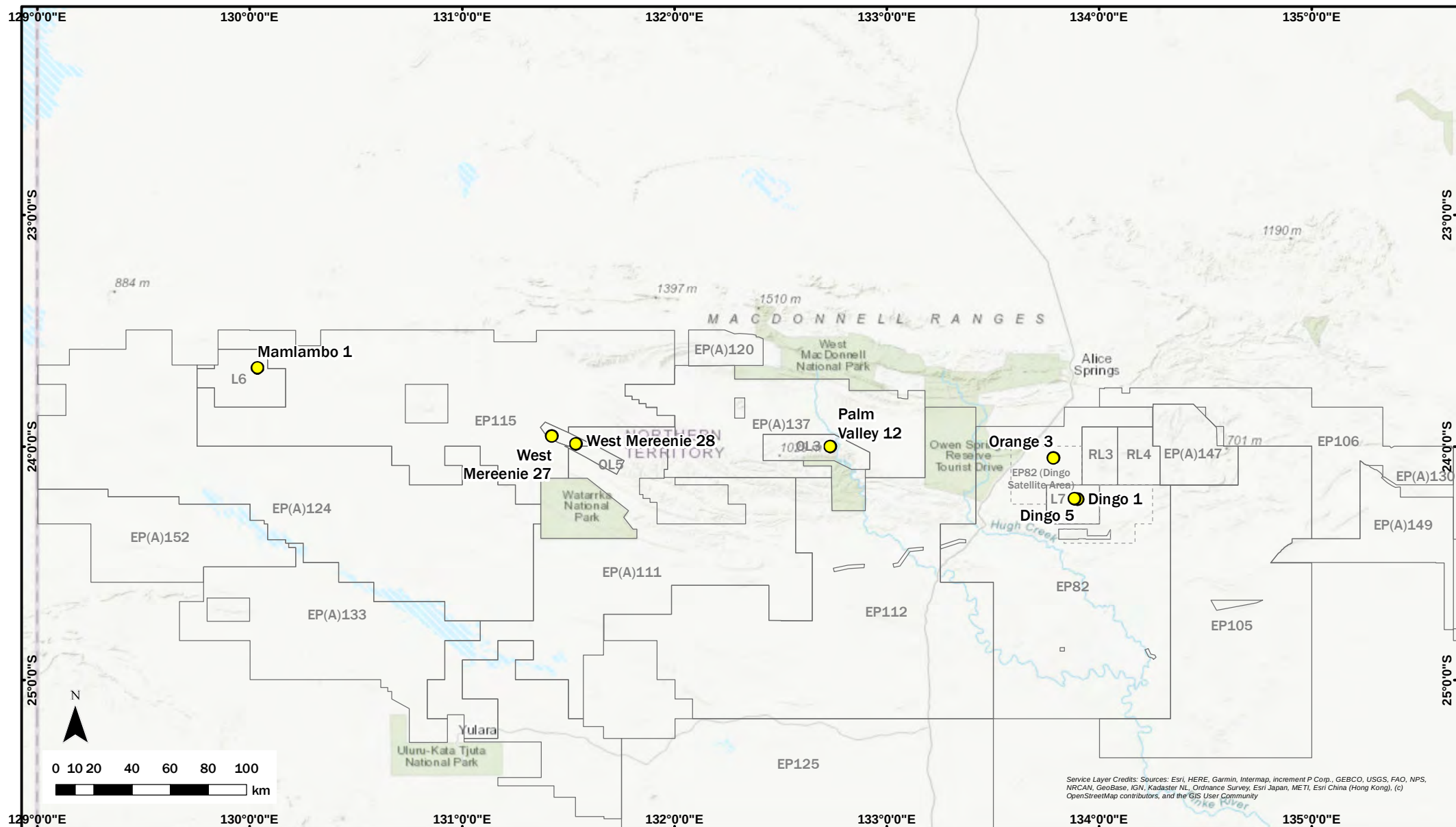
* These wells will be completed to a development well under this EMP if commercial quantities of gas are discovered

The seven wells are located in geographically diverse areas of the Northern Territory, with all wells targeting formations within the Amadeus basin. No hydraulic stimulation of the wells is required during this drilling campaign.

Throughout this Environmental Management Plan (EMP) the following naming conventions have been applied to the various locations:

- Dingo wells - refers to the Dingo-1 ST1 and Dingo-5 well leases and associated infrastructure for each well (well lease, flowline, access track, camp and vehicle turnarounds)
- Orange-3 well – refers to the Orange-3 well lease and associated infrastructure (well lease, flowline, access track, camp and vehicle turnarounds)
- West Mereenie wells – refers to the West Mereenie-27 and West Mereenie-28 well leases and associated infrastructure for each well (well lease, flowline, access track and vehicle turnarounds)
- PV12 well - refers to the PV12 well lease and associated infrastructure (well lease, flowline, access track and vehicle turnarounds.)
- Mamlambo-1 well - refers to the Mamlambo-1 well lease and associated infrastructure (well lease, flowline, access track and vehicle turnarounds).

This EMP provides a detailed description of how CP proposes to manage the environmental impacts and risks associated with its activities, including how it will address its regulatory obligations that have underpinned the Code of Practice for Petroleum Activities in the Northern Territory (referred to herein as the Code of Practice).



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 Rev:
 Date: 1/06/2020
 Map Scale is 1:2,716,742 when printed at A4
 Coordinate System: WGS 1984 Web Mercator Auxiliary

Figure 1-1: Drilling Campaign Locations

● Proposed well locations

□ CTP Permits



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1.2 Title Holder

Table 1-2 provides details of the permit titleholder and the titleholder's nominated liaison person for the drilling campaign. CP is the operator within all the title areas.

Table 1-2 Details of Titleholder and Nominated Liaison

Title	Title Holder	Nominated Liaison for EMP
L7, OL3	Central Petroleum (NT) Pty Ltd (100%)	Name: Dr Duncan Lockhart Position – General Manager Exploration Company – Central Petroleum Limited Address: 7/369 Ann Street, Brisbane QLD 4000 Phone: +61 (0)7 3181 3800 E-mail: info@centralpetroleum.com.au
L6	Frontier Oil and Gas Pty Ltd (100%)	
OL4	Central Petroleum Mereenie Pty Ltd (50%) Santos QNT Pty Ltd (43.75%) Santos Limited (6.25%)	
EP82	Helium Australia Pty Ltd (60%) Santos QNT Pty Ltd (40%)	

1.3 Purpose

The purpose of this EMP is to demonstrate how CP will conduct its scope of activities under the EMP in a manner consistent with the principles of ecologically sustainable development (ESD) and such that impacts and risks are reduced to as low as reasonably practicable and acceptable levels.

More specifically, this EMP aims to:

- Address regulatory requirements
- Provide site-specific impact management strategies to assist CP in maintaining a positive position in the local community throughout its campaign
- Provide a description of site-specific aspects of the existing environment (physical, biological and social)
- Provide site-specific plans for review, monitoring and rehabilitation
- Be a practical and usable document, with environmental management principles that are easily implemented and effective.

1.4 Scope

CP proposes to undertake a 7 well drilling campaign. The 7 wells and their locations are shown in Figure 1-1 and summarised in Table 1-1. A full description of the activities proposed to be undertaken at each of the wells is provided in Section 4.0.

2.0 Commitment to the Environment

2.1 Environmental Policy

CP has a high standard of environmental responsibility implemented through operational quality and integrity measures above and beyond industry standards. CP has a strong environmental commitment focus through all its facilities and operations, being at the forefront of policy and management strategy developments. CP has compiled this EMP and developed mitigation and preventative measures and standards to ensure the 2020-21 Drilling Program has the smallest ecological footprint as possible. Also, to ensure that any impacts or incidents that have the potential to result in environmental degradation are identified and remediated as soon as possible. The employees and contractors of CP, both office and field, have been briefed on the company's policy, standards and expectations.

CP corporate environmental policy is provided in Plate 3.1 and the corporate Health, Safety, Security and Environment (HSE) policy is provided in Plate 3.2.

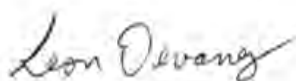


ENVIRONMENTAL PROTECTION POLICY

Central Petroleum Limited considers protection of the natural and social environment to be of the highest priority in all its activities, both domestic and international, and conducting its operations in an environmentally responsible manner.

It is Central Petroleum's policy to:

- Comply, at a minimum, with applicable laws, regulations, standards, codes and guidelines for the protection of the environment and cultural heritage, and in their absence, adopt the best practicable means to prevent or minimise adverse environmental and cultural heritage impacts;
- Cooperate with governments and industry in the formulation of rational and practical environmental and cultural heritage guidelines and legislation;
- Continuously develop the company's environmental management system and cultural heritage management plans to identify, control and monitor risks and compliance with government regulations and industry guidelines, utilising the most appropriate technology available;
- Commit all levels of management to accept responsibility for environmental and cultural heritage management in all Central Petroleum activities;
- Promote environmental and cultural heritage awareness in all Central Petroleum employees and contractors through induction and training programs;
- Maintain cooperative and positive relationships with indigenous people with custodial responsibility for the land where Central Petroleum operates to minimise the impact of those operations on the cultural heritage of the indigenous people, and cooperate with other legitimate land users so that, where appropriate, multiple land use is possible;
- Conduct all Company operations in such a way as to minimise disturbance to the environment, protect native flora and fauna, avoid the pollution of land, water and air, and avoid disturbance of known sites of archaeological, cultural heritage, historical, natural or scientific significance; and
- Maintain an active rehabilitation program that will restore operational areas to a condition which is compatible with the prior land use.



Leon Devaney
Managing Director
5 September 2019

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Plate 3.1 CP's Corporate Environmental Policy

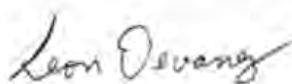


HEALTH, SAFETY, SECURITY & ENVIRONMENT POLICY

Central Petroleum Limited believes that effective management of Health, Safety, Security and the Environment (HSSE) to be of the highest priority in all its activities and it is essential for success in its business, by:

- Providing leadership and commitment to HSSE issues and communicating our expectations to employees, contractors and other stakeholders;
- Providing clear direction and monitoring of a zero drug and alcohol tolerance to all contractors and employees at all Central Petroleum managed work sites, offices and operations.
- Zero tolerance to smoking in any workplace, except designated areas;
- Complying with national, state and local legislation;
- Providing a safe working environment for all employees, contractors and third-party personnel;
- Minimising the impact of our activities on the environment;
- Selecting and managing contractors to ensure their HSSE performance meets the statutory and Company requirements;
- Carrying out risk assessments and taking effective measures to reduce risks to as low as reasonably practicable on all our operations;
- Providing sufficient training, resources, equipment and personnel to achieve our HSSE objectives;
- Maintaining appropriate HSSE documentation;
- Monitoring HSSE performance-investigating and reporting all incidents and accidents regularly to the Board of Directors as well as relevant authorities;
- Striving for continuous improvement;
- Ensuring effective emergency response procedures are in place;
- Supporting wherever possible the advancement of local communities in areas where we operate;
- Conducting audits and reviews to assess compliance with this policy; and
- Implementing and using management systems for integrity management of plant, pipelines and equipment.

It is the responsibility of all employees and contractors to comply with this policy and to assist Central Petroleum Limited in its implementation.



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5 September 2019

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Plate 3.2 CP's Corporate HSSE Policy

3.0 Environmental Legislation and Other Requirements

3.1 Key Legislation

Schedule 1 of the *Petroleum (Environment) Regulations 2016* requires the EMP to specify the legislative requirements that are relevant to the protection of the environment for activities conducted under the EMP and to demonstrate how those requirements will be met. These requirements are provided in Table 3-1 .

Table 3-1 Summary of legislative requirements

Relevant Legislation	Applicable Legislative Requirement	Responsible Agency	Actions
Commonwealth			
<i>EPBC Act</i>	Referral of proposed action / environmental approval	Department of Agriculture, Water and Environment	CP has assessed its potential impact on MNES and there is not likely to be a significant impact on MNES. CP will not be referring activities under this EMP to the Federal Government for assessment
<i>National Greenhouse and Energy Reporting Act 2007</i>	Reporting under National Greenhouse and Energy Reporting Scheme	Australian Government - Clean Energy Regulator	CP's activities contribute to triggering the threshold for reporting and must report greenhouse gas emissions, energy production and energy consumption data to the Federal government annually
<i>National Environment (National Pollution Inventory) Protection Measure 1998</i>	Reporting under the National Pollution Inventory (NPI)	Department of Agriculture, Water and Environment (NPI)	CP's activities may contribute to triggering the threshold for NPI reporting and CP must report pollution data to the NPI annually if any of the NPI thresholds are triggered.
NT			
<i>Petroleum Act 1984</i>	Petroleum Titles	Department of Industry, Tourism and Trade (DITT)	CP has obtained the necessary petroleum titles to undertake the activities listed in this EMP
<i>Petroleum Act 1984</i>	Land Access Agreements	DITT	Land Access Agreements which cover the scope of activities under this EMP will be in place prior to commencing activities under this EMP
<i>Schedule of Onshore Petroleum Exploration and Production Requirements (2019)</i>	Mandatory schedules for the exploration or development of petroleum for the petroleum industry to ensure that petroleum activities in the Northern Territory are managed according to minimum acceptable standards	DITT	CP has developed the Safety Management Plan, Emergency Response Plan, Well Operations Management Plan in accordance and Reservoir Management Plan per the minimum standards outlined in the Schedule.
<i>Bushfire Management Act</i>	Permit to burn / Bushfire Management	Bushfires NT	CP has included a bushfire management plan consistent with the requirements of

Relevant Legislation	Applicable Legislative Requirement	Responsible Agency	Actions
2016 / Bushfire Management Planning Guide: Onshore Petroleum Projects	Plan		the Act and the Bushfire Management Planning Guide: Onshore Petroleum Projects Permits to burn will be obtained on an as needs basis in accordance with the Act
<i>Petroleum (Environment) Regulations 2016</i>	Approved EMP	Department of Environment, Parks and Water Security (DEPWS)	CP will have in place an approved EMP to conduct its drilling campaign
<i>Code of Practice: Onshore Petroleum Activities in the Northern Territory (2019)</i>	Activities to be performed under an EMP are to be consistent with the Code of Practice	DEPWS	The EMP to be submitted for approval is to be consistent with the Code of Practice
<i>Environment Protection Act 2019</i>	Referral of proposed action / environmental approval	EPA	CP is of the view that the activities proposed under this EMP do not have a significant impact on the environment (or meet a referral trigger) and that referral of the activities under this EMP is not required
<i>Northern Territory Aboriginal Sacred Sites Act 1989</i>	Must not enter, damage or interfere with a Sacred Site without authorisation (even if not registered)	AAPA	CP has obtained AAPA certificates for the drilling program. CP commits to abiding by the conditions on the certificates.
<i>Water Act 1992</i>	Groundwater extraction licence	DEPWS	Existing groundwater bores will be used for the Mamlambo-1 well and West Mereenie wells. CP will obtain a licence for groundwater extraction as part of this drilling campaign.
<i>Heritage Act 2011</i>	Work approval (for removal or damage of archaeological sites)	DEPWS	Application for works approval to be made for the Palm Valley-12 well.
<i>Radiation Protection Act 2004</i>	Disposal of radiation sources (NORM)	Department of Health	CP to undertake NORM testing as outlined in EMP. If limits specified in the Act are exceeded, disposal of the material to be in accordance with the Act.
<i>Public and Environmental Health Act 2011</i>	Wastewater management	Department of Health	CP to abide by the <i>Code of Practice for on-site Wastewater Management</i>
<i>Territory Parks and Wildlife Conservation Act 1976 (TPWC Act)</i>	Protects wildlife and listed threatened species in the Northern Territory and provides related offenses	DEPWS	CP's activities have been located so as not to cause a significant impact on wildlife or threatened species protected by the Act. Works to be conducted in accordance with the Act.
<i>Work Health and</i>	Provides for	NT WorkSafe	CP to undertake activities in accordance

Relevant Legislation	Applicable Legislative Requirement	Responsible Agency	Actions
<i>Safety (National Uniform Legislation) Act 2011</i>	occupational health and safety measures associated with petroleum activities		with the Act, including reporting of incidents
<i>Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Regulations 2011</i>	Dangerous goods can only be transported by appropriately licensed personnel and within licensed vehicles	NT WorkSafe	CP to ensure that any dangerous goods transportation that occurs above the trigger levels are done so by appropriately licensed transportation personnel (including vehicles)
<i>Waste Management and Pollution Control Act 1998</i>	Protects, restores and enhances the environment through pollution control mechanisms and related offenses	EPA	CP activities will be conducted in accordance with the Act and associated regulations including waste handling, storage and transport measures to prevent pollution, waste tracking, re-use and recycling of waste where possible.
	General environmental duty, duty to notify of incidents of actual or potential pollution and related offenses	EPA	Where activities occur outside of leases (e.g. transportation etc) CP and its operators must abide by the general environmental duty. An example of this would be following the NT Contaminated Land Guideline (2017) if a contamination event occurred Where an incident occurs which causes or threatens to cause material or serious environmental harm, CP will notify the NT EPA as soon as practicable and within 24 hours of becoming aware of the incident
	Licensed waste disposal and transport	EPA	CP will ensure that all waste, including listed waste as per Schedule 2 Waste Management and Pollution Control (Administration) Regulations 1998, is removed from the respective well locations by an appropriately licensed transporter and disposed/recycled/treated at an appropriately licenced facility.
<i>Weeds Management Act 2001</i>	Defines weed declaration classes and statutory weed management plans	DEPWS	CP to ensure its activities are consistent with statutory weed management plans and undertakes weed management activities consistent with weed declaration classes

3.2 Key Codes of Practice and Guidelines

The key codes of practice and guidelines relevant to the activities described in this EMP are summarised in Table 3-2 .

Table 3-2 Key codes of practice and guidelines

Document	Summary
<i>Code of Practice: Onshore Petroleum Activities in the Northern Territory (2019)</i>	Mandatory Code of Practice for the petroleum industry to ensure that petroleum activities in the Northern Territory are managed according to minimum acceptable standards to ensure that risks to the environment can be managed to a level that is as low as reasonably practicable (ALARP) and acceptable
<i>Code of Practice for on-site Wastewater Management (2014)</i>	Stipulates the approved sewage and sullage treatment devices and practices within the Northern Territory. Sewage and sullage produced and disposed of from the camps must be undertaken in accordance with the Code
<i>Australian Pipeline Industry Association Code of Environmental Practice – Onshore Pipelines (2017)</i>	Provides industry accepted guidance on environmental management through the planning and asset acquisition, construction, operational and decommissioning phases of a pipelines' lifecycle
<i>APPEA Code of Environmental Practice (2008)</i>	Provides an outline of environmental objectives which represent guidance on key aspects of good environmental practice in the petroleum industry
<i>Best Practice Erosion and Sediment Control (2008)</i>	Facilitates the identification of those issues that should be considered when formulating and evaluating strategies for best practice erosion and sediment control. Facilitates best practice stormwater management. Facilitates active avoidance or minimisation of soil erosion resulting from construction activities. Facilitate best practice soil and sediment control management on sites. Erosion and sediment Control Plan covering petroleum exploration activities are developed in accordance with these guidelines
<i>Northern Territory Noise Management Framework Guideline (2018)</i>	Assists and provides guidance to the community and industry about the noise regulatory framework as it applies in the Northern Territory. It addresses the noise issues that the Northern Territory Environment Protection Authority (EPA) and other noise regulators deal with on a day to day basis so that the community is aware of its rights and responsibilities
<i>Weed Management Planning Guide - Onshore Petroleum Projects (2019)</i>	Provides guidance to the industry about the weed management planning required to undertake onshore petroleum projects in the Northern Territory
<i>Land Clearing Guidelines (2019)</i>	Outlines good land development practice in the Northern Territory by establishing standards for the management (i.e. clearing and retention) of native vegetation. The guidelines aim to assist in preventing environmental degradation associated with clearing and help to support the sustainable development of the Northern Territory's natural resource based economy.
<i>Bushfire Management Planning Guide: Onshore Petroleum Projects (2019)</i>	Guide to assist interest holders of onshore petroleum projects in the preparation of a Bushfire Management Plan as a component of an EMP under the <i>Petroleum (Environment) Regulations 2016</i> and in accordance with the Code of Practice

Document	Summary
<i>Stakeholder Engagement Guidelines Land Access (2016)</i>	Provides the framework for consistent stakeholder engagement to obtain land access for exploration activities
<i>Minimum Construction Requirements for Water Bores in Australia (2012)</i>	Provides a technical basis for, and a description of, the minimum requirements for constructing water bores in Australia.
<i>ISO 31000 Risk Management – Principles and guidelines</i>	Outlines the process to be followed to ensure the risk assessment process is undertaken in accordance with best practice requirements

3.3 Environment Protection Act 2019

Under the *Environment Protection Act 2019*, proposed projects / action that may have a significant impact on the environment (or meet a referral trigger) are to be referred to the NT EPA for assessment. CP's proposed action does not have the potential to have a significant impact on the environment or location-based impacts to features of natural or cultural environments. The assessment is based on consideration of the potential impacts of the activities on the environment cumulatively and locally through the development of this EMP. Based on this assessment, CP is of the view that the activities covered by this EMP do not trigger referral to the NT EPA.

In addition, The CP 2020-21 Drilling Program aligns with the principles of ESD through the adoption of responsible practices that are designed to maximise social benefit, whilst minimising the level of impact on the surrounding ecosystems. CP's activities align with the principles of ESD through the following:

- The drilling and exploration activities are essential to maintain and expand the commercial resource CP has and can generate sustainable, long-term benefits to the local community and to the NT (Principle of sustainable use; Decision-making Principle);
- Based on the risk assessment and management actions contained in sections 6.0 and 8.0 respectively of this EMP, the activities under this EMP do not constitute threats of serious or irreversible environmental damage and there is no impact on the conservation of biological diversity and ecological integrity (Principle of conservation of biological diversity and ecological integrity; Principle of intergenerational and intragenerational equity).

For example:

- Existing infrastructure has been used where practical to reduce new ground disturbance
- Well locations have been located to avoid impacts to flora and fauna habitat
- New access tracks have been located to avoid impacts to flora and fauna habitat;
- Activities under the EMP comply with the Petroleum Code of Practice to reduce any risk to the environment and communities to an acceptable level (Principle of evidence based decision-making; Decision-making Principle; Principle of sustainable use; Principle of conservation of biological diversity and ecological integrity; Principle of intergenerational and intragenerational equity);
- Royalty payments to the NT Government (as owner of the natural resource), and payments to Native Title Holders (as per Exploration Agreements) and host pastoralists (as per Land Access Agreements) (Decision-making Principle);

- CP seeks to maximise local participation in training and employment opportunities (Decision-making Principle);
- Prioritising the use of local employment to deliver drilling and construction activities (Decision-making Principle);
- Obtaining sacred site clearances from host Traditional Owners through open engagement with custodians and the Statutory Representative body - the Central Land Council (CLC) (Decision-making Principle); and,
- Obtaining Land Access Agreements with host pastoralists (Decision-making Principle).

Stakeholder engagement has been undertaken with the NT community about the proposed action, which is detailed in Section 11.0. No objections to the activity have been received.

3.4 EPBC Act and Referral Self-Assessment

Under the EPBC Act an action that has, will have or is likely to have a significant impact on Matters of National Environmental Significance (MNES), must be referred to the Australian Government for assessment.

A self-assessment in accordance with the EPBC Act was undertaken for the activities under this EMP and it was determined that significant impacts to MNES were unlikely to occur.

4.0 Description of Activity

4.1 Well Lease, Flowline, Access Route and Camp Selection

The well leases, flowlines, access track and camp locations have been designed using a multi-criteria analysis (MCA) which covers several disciplines including cultural, environmental, leaseholder, regulatory and constructability requirements. The MCA relies upon both desk-top and ground-truthed information to provide the optimal location of the infrastructure. Examples of where the MCA has informed the proposed locations are as follows:

- Dingo-5 well was relocated to be adjacent to an existing access track to reduce the amount of new access track and flowline ground disturbance required. The proposed flowline and access track turn in follow an existing seismic line clearing
- All proposed wells utilise existing access tracks, seismic lines within their respective operational fields and landowner tracks to the greatest extent possible, thereby minimising the amount of new access tracks required.
- All well locations have been sited to avoid conservation significant flora and fauna habitat. The only sites where this was not possible was at Palm Valley-12, West Mereenie 27 and West Mereenie 28. Below is an overview of the impacts to the near threatened species and/or potential habitat, context and controls:
 - Ecological surveys at PV12 recorded two Near Threatened flora species in the area (*Eucalyptus lucens* and *Stenanthemum centrale*), as well as and other constraints for the well location (e.g. topography) as shown in Figure 4-5. As such, the well pad has been positioned to minimise disturbance to Near Threatened species by implementing the vegetation buffer proposed in the ecological assessment, which avoids all occurrences of *Eucalyptus lucens* and the majority of *Stenanthemum centrale* (only one shrub was observed in the proposed well pad area). Advice from suitably qualified ecologists has confirmed that the proposed siting of the well pad will not significantly impact the population of these Near Threatened species in the local area, or the surrounding region (refer to Appendix 2).
 - Ecological surveys at WM27 indicate that Southern Marsupial Mole (*Notoryctes typhlops*) has a low likelihood of occurrence in dune habitat (described as land type WM27-B in Appendix 2). Although the likelihood of occurrence (and inherent risk of impact) is low, CP have sited infrastructure to minimise disturbance of dune habitat to further mitigate potential impacts to the species. However, total avoidance of dunes was not possible due to multiple constraints including the sub-surface target, topography and Cultural Heritage restrictions (see Figure 4-2). Consequently, a small area of dune habitat is required to be cleared (only 0.03 Ha will be disturbed). This small scale clearing of low likelihood habitat is not considered to cause a significant impact to this species.
 - Ecological surveys at WM28 indicate that Southern Marsupial Mole (*Notoryctes typhlops*) has a low likelihood of occurrence in dune habitat (described as land type WM28-G in Appendix 2). Although the likelihood of occurrence (and inherent risk of impact) is low, CP have sited infrastructure to minimise disturbance of dune habitat to further mitigate potential impacts to the species. The proposed well pad and flowline locations have been positioned to avoid dunes; however, a small area of dune habitat is proposed to be cleared for establishment of site access tracks (see Figure 4-3). This disturbance is unavoidable due to the constraints of the CLC and AAPA clearance certifications (see Figure 4-3). This is a small scale clearing (0.04 Ha) of low likelihood habitat and is not considered to cause a significant impact to this species.

- Ecological surveys at Mamlambo - 1 indicate that Southern Marsupial Mole (*Notoryctes typhlops*) has a low likelihood of occurrence in dune habitat (described as land type M1-C in Appendix 2). Although the likelihood of occurrence (and inherent risk of impact) is low, CP have sited infrastructure to minimise disturbance of dune habitat to further mitigate potential impacts to the species. The proposed well pad has been positioned to avoid dunes; however, the access track intersects two small dunes. There is an existing seismic line disturbance through the dunes, which will be used for the access road. The small amount of preparation work in the existing disturbance in low likelihood habitat is not considered to cause a significant impact to this species.
- All wells are located more than 2 km from any sensitive receptors (dwellings, workplace buildings, schools, sporting facilities, hospitals or other community medical facilities)
- No well locations are located within 8km of a major public roads
- Siting of well pads and access tracks has been in consideration of the Land Clearing Guidelines (LCG):
 - PV12 was the only site assessed with a high risk drainage feature that a 25m buffer has been applied to. Figure 4-5 shows that the well footprint slightly encroaches on the 25m buffer, this is due to other constraints which include the sub-surface target, topography, ecological and cultural heritage constraints. To minimise the impacts to the drainage feature and ecological features within the gully erosion sediment controls described in Appendix 5 will be implemented.
 - The proposed Orange-3 proposed well pad location and access turn around are within the 200m buffer for cadastral boundaries as indicated in Figure 4-4. The well has been located to access the sub-surface target and minimise the impacts to ecology, cultural heritage and erosion and sediment considerations due to topography. CP has mitigation in place to work within the LGC buffer including the Bushfire Management Plan In Appendix 7, the Erosion and Sediment Plan in Appendix 5 and progressive rehabilitation procedures under the Rehabilitation Plan in Section 7.8.
- Wells pads and access roads have been assessed to minimise impacts from flood or erosion
- Existing camp sites or areas previously cleared for camps (or well sites which are large enough to accommodate a camp) are being used for the workforce during the drilling activities.
- Access track to the Mamlambo-1 well lease follows an existing previously cleared seismic line.
- The proposed access track at Orange 3 has been designed to avoid clay loam depressions.

To enable further refinement of proposed disturbance areas for the well leases, access routes and camp, baseline assessments and AAPA Authority Certificates have assessed a larger footprint than what is required for the campaign. The EMP seeks authorisation of these larger footprints (referred to as clearance areas) whilst limiting the amount of new ground disturbance within these clearance areas to that provided in Table 4-1 .

Table 4-1 Proposed Ground Disturbance Areas

Well Location	Survey Clearance Area (Ha)	Access disturbance area (Ha)	Flowline disturbance area (Ha)	Camp disturbance area (Ha)	Area (Ha)	Total Disturbance (Ha)	% of permit
Dingo 1ST	35			0.35	2.25	2.6	0.01%
Dingo 5	44	0.93			2.25	3.18	
Mamlambo 1	21.5	2.89			1.44	4.33	0.005%
Orange 3	38.5	1.44		0.35	2.25	4.04	0.0003%
PV 12	12	0.14	0.29		2.21	2.64	0.004%
WM 27	31	1.01	0.09		2.25	3.35	0.07%
WM 28	24	1.36	1.95		2.25	5.57	

Figure 4-1 to Figure 4-6 show the proposed clearance areas for each of the well locations.

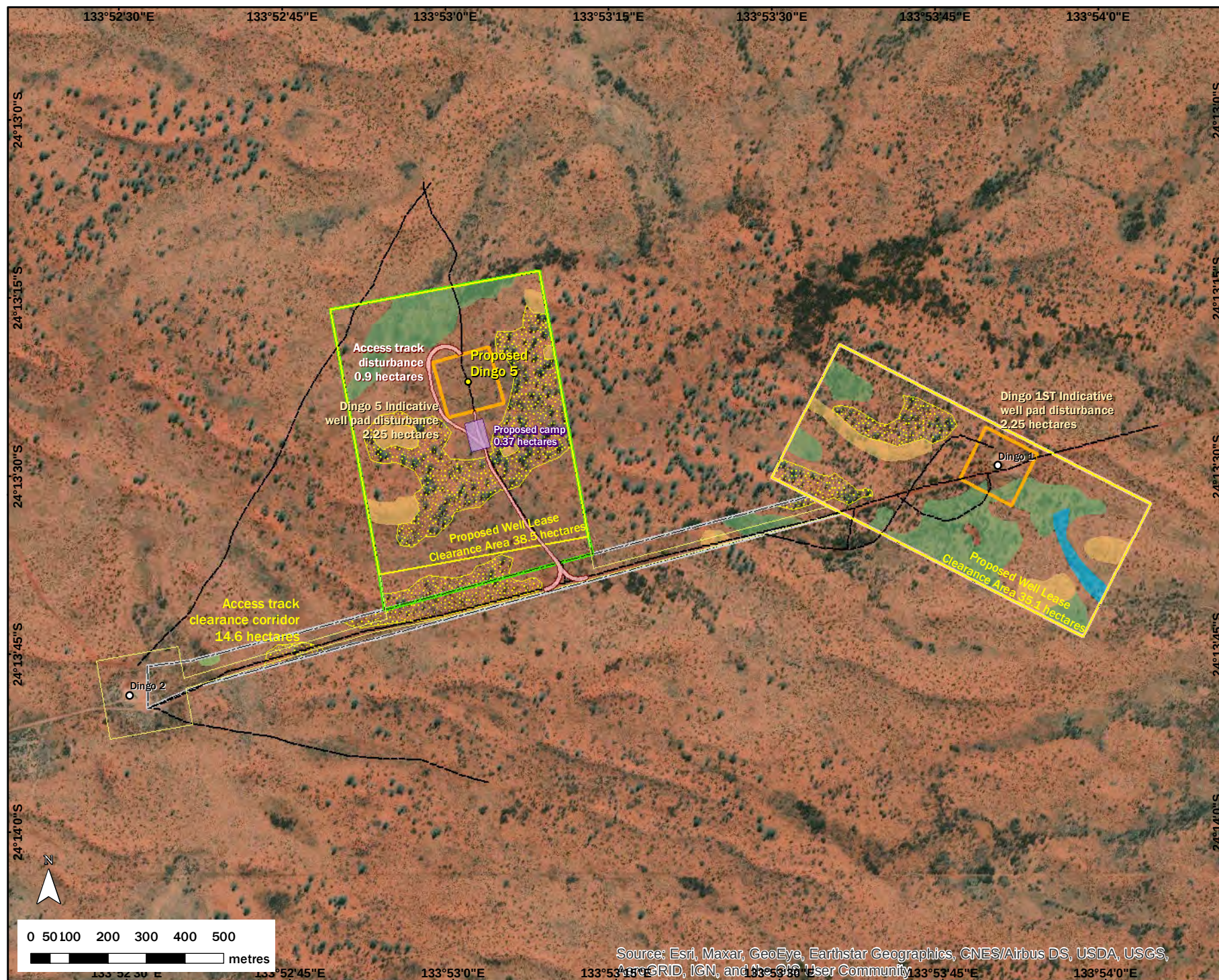


Figure 4-1 Dingo 1 & 5

- Indicative well location
- Existing wells
- Proposed camp
- Proposed access disturbance area
- Proposed Well Lease Clearance Area
- Proposed access corridors
- Existing tracks or seismic lines
- Indicative well pad disturbance
- Dingo 1 ST survey area
- Dingo 5 survey area
- Access corridor survey area

Ecological values

- Mulga depressions (land type DG-C); drainage feature (low ecological significance, so no buffer proposed)
- Minor Mulga drainage (land type DG-F) is considered as a 1st order stream (low ecological significance, so no buffer proposed)
- Sand dunes (land type DG-D); suitable habitat for Southern
- Marsupial Mole (threatened species) (low likelihood of occurrence)
- Mature Desert Oak trees (mostly within land type DG-B); large old trees.

ID: 0523-201
Rev: 8
Date: 23/10/2020

Map Scale is 1:13,169 when printed at A4
Coordinate System: GDA 1994 MGA Zone 53

Ecology buffers - EcOz (Feb 2020)



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Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

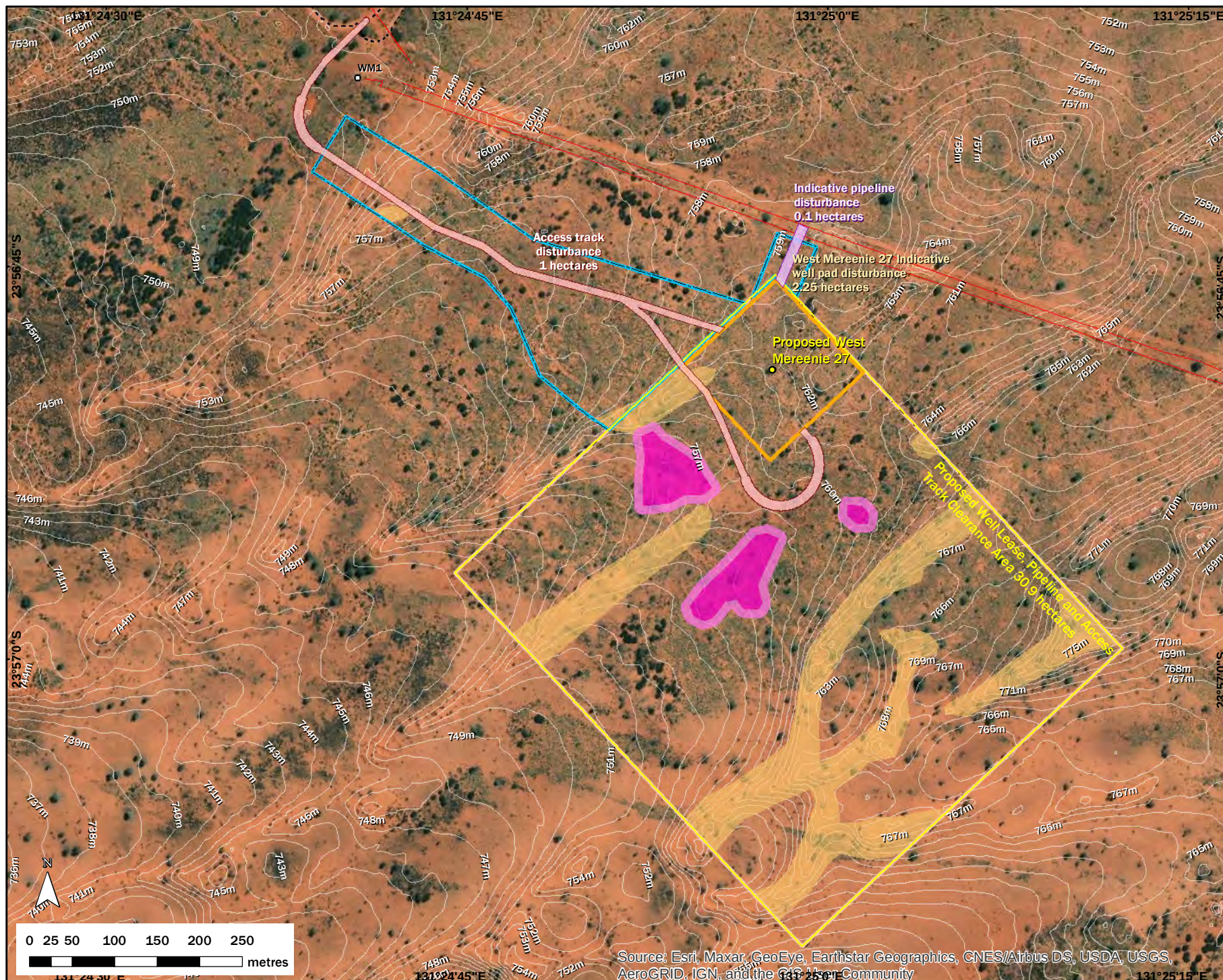


Figure 4-2 WM - 27

- Indicative well location
 - Heritage Exclusion Area
 - Heritage Exclusion Area 10m buffer
 - Proposed access disturbance area
 - Proposed pipeline disturbance area
 - Indicative well pad disturbance
 - Existing wells
 - Existing tracks or seismic
 - Gas pipeline
 - Proposed Well Lease, Pipeline and Access Track Clearance Area
 - Ecological survey area (access and pipeline)
 - Ecological survey area (well pad)
- Key ecological values**
- Sand dunes (land type WM27-B); low likelihood of occurrence for Southern Marsupial Mole (threatened species)

ID: 0523-205
Rev: 8
Date: 23/10/2020

Map Scale is 1:6,000 when printed at A4
Coordinate System: GDA 1994 MGA Zone 52

Ecology buffers - EcOz (Oct 2020)



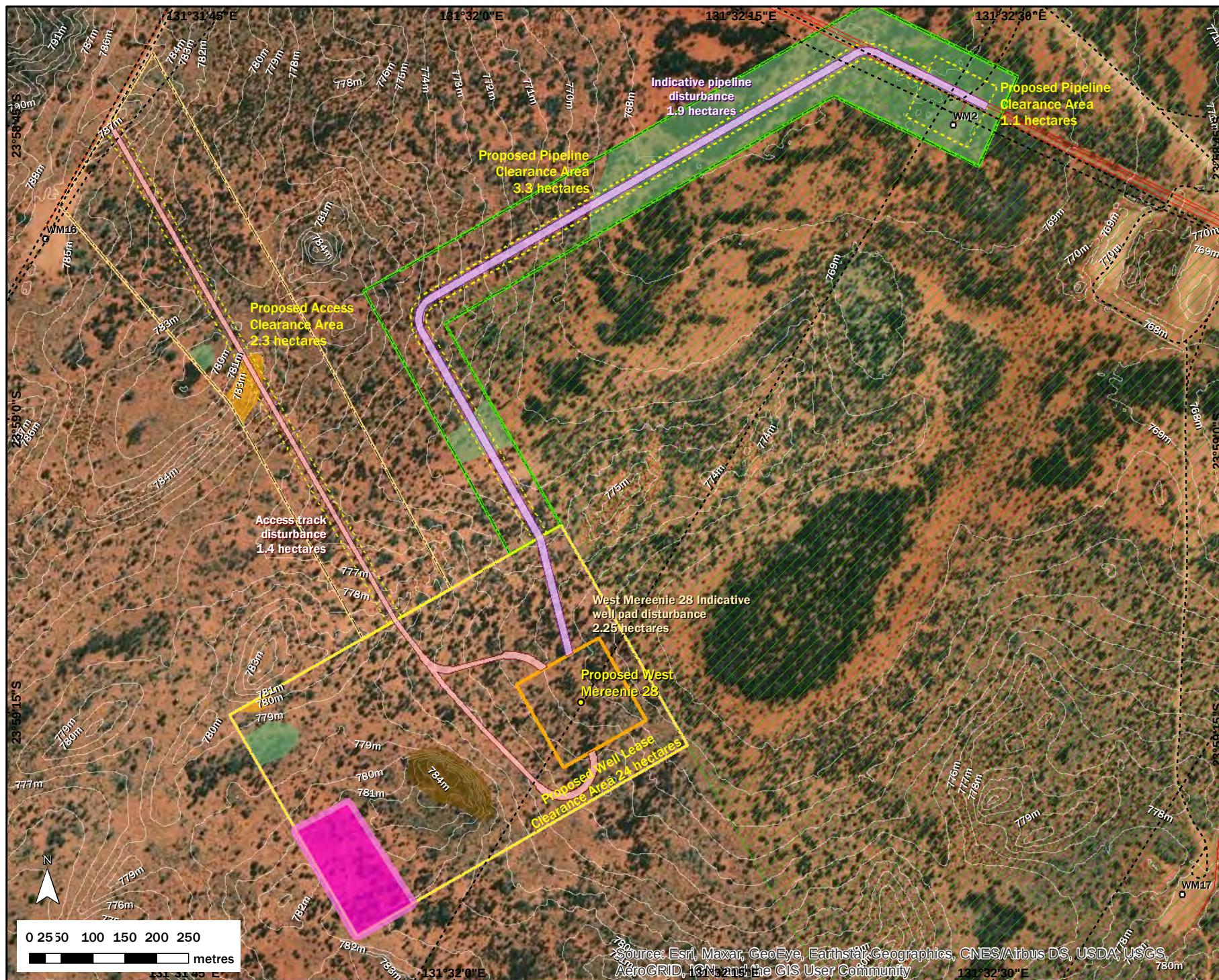


Figure 4-3 WM 28

- Indicative well location
- Existing tracks or seismic
- Heritage Exclusion Area
- Heritage Exclusion Area 10m buffer
- Proposed access disturbance area
- Indicative pipeline disturbance area
- Indicative well pad disturbance
- Existing wells
- Gas pipeline
- Proposed Well Lease Clearance Area
- Proposed Pipeline and Access Clearance Areas
- CLC SSCC zones
- RWA
- Ecology survey areas
- Well site survey area (field)
- Western access option (field)
- Eastern access option (desktop)
- Ecological values
- Rocky breakaway (land type WM28-D); locally important habitat; steep terrain
- Land type WM28-G; suitable habitat for Southern Marsupial Mole (threatened species) (low likelihood of occurrence)
- WM28-C; drainage feature (low ecological significance so no buffer proposed)

ID: 0523-206
Rev: 8
Date: 23/10/2020
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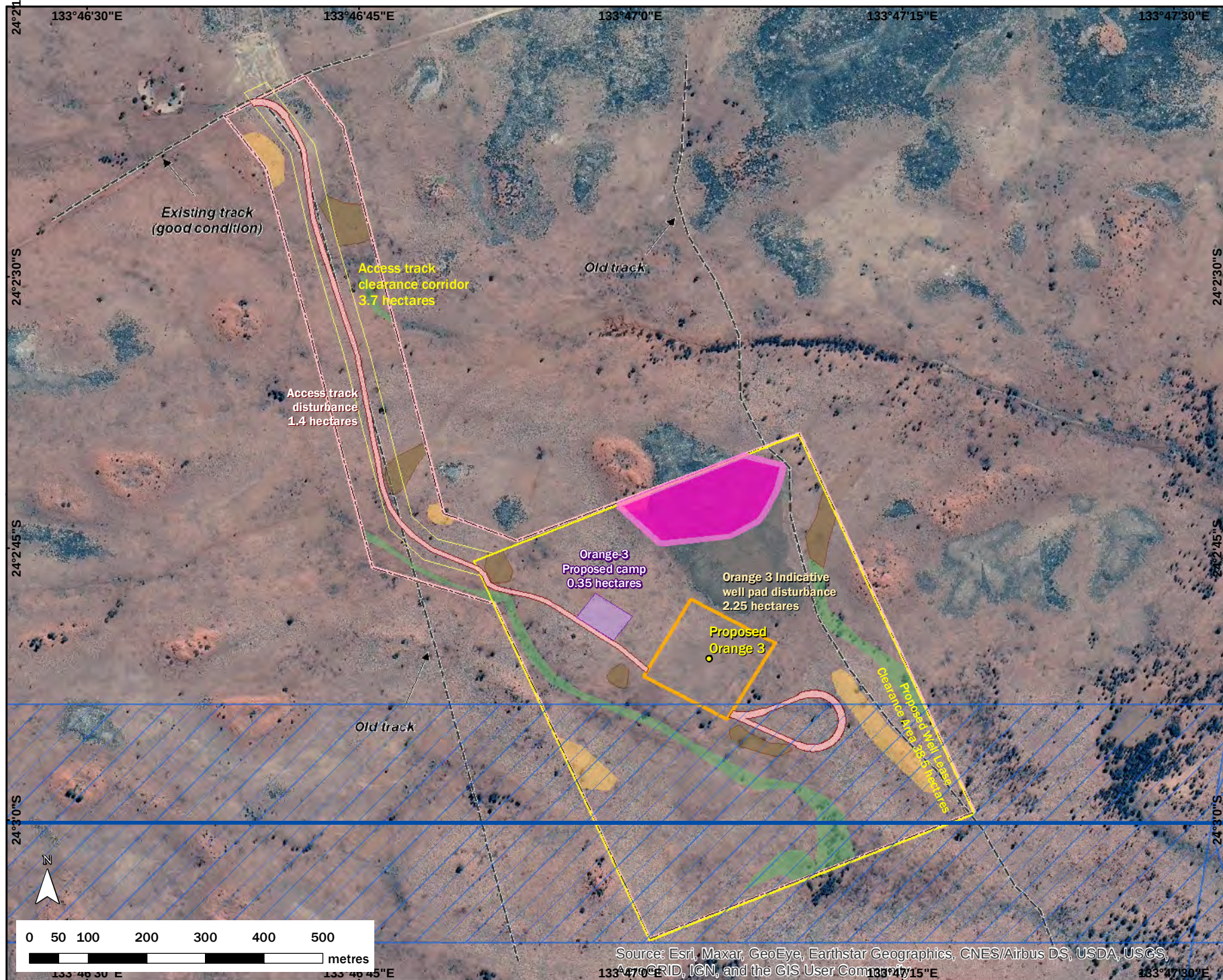


Figure 4-4 Orange 3

- Indicative well location
- LCG property boundary
- Proposed Orange 3 camp
- LCG property boundary 200m buffer
- Heritage Exclusion Area
- Heritage Exclusion Area 10m buffer
- Proposed access disturbance area
- Indicative well pad disturbance
- Proposed Well Lease Clearance Area
- Proposed access corridors
- Ecological survey area

Ecological values

Clay loam depressions (land type O3-D) (not considered as claypan); drainage feature (low ecological significance so no buffer proposed)

Mulga depressions and minor drainages (land type O3-F); drainage feature (low ecological significance so no buffer proposed)

Low rocky rise (land type O3-C); steep terrain

Low sand dune (land type O3-E); steep terrain

ID: 0523-203
Rev: B
Date: 23/10/2020

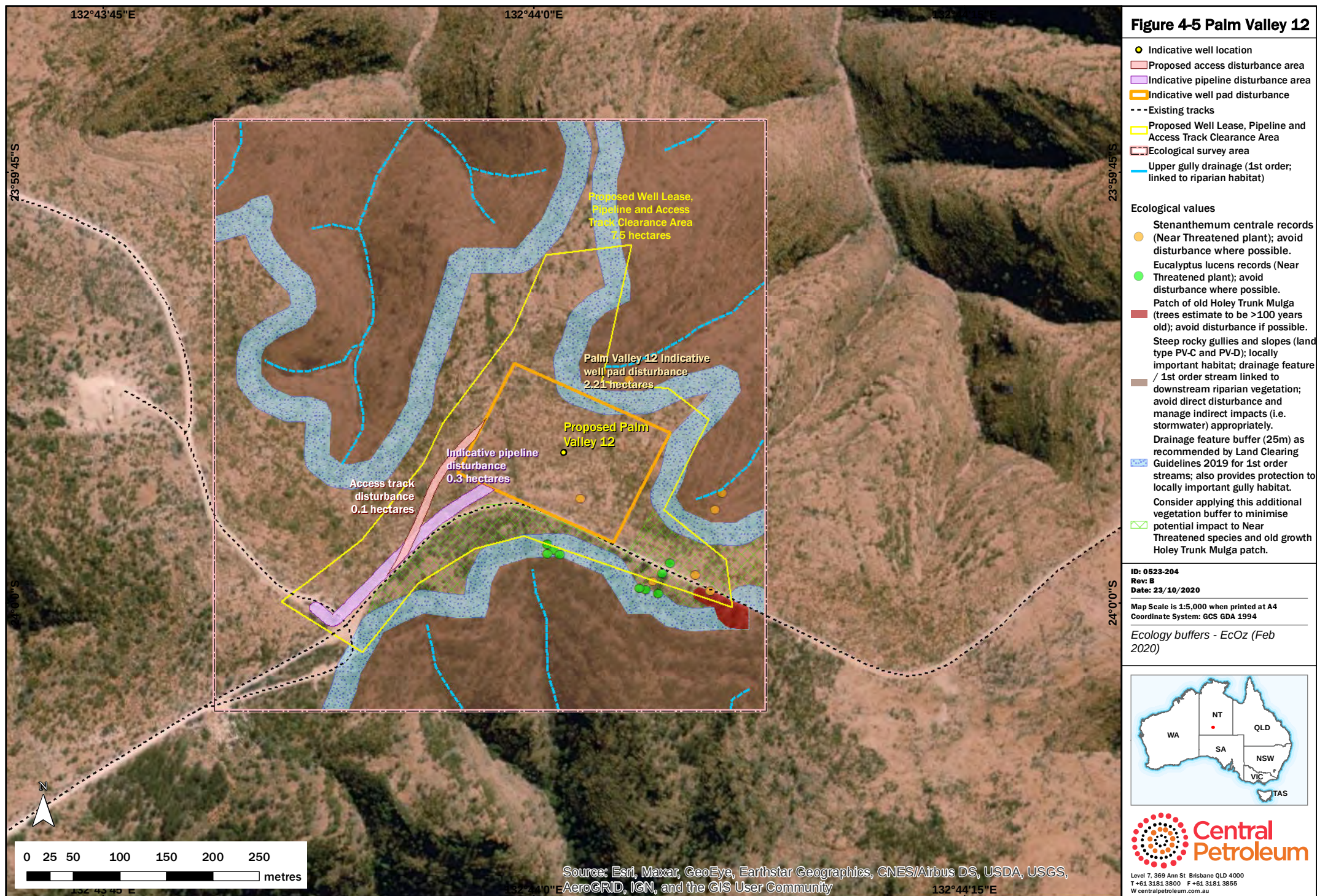
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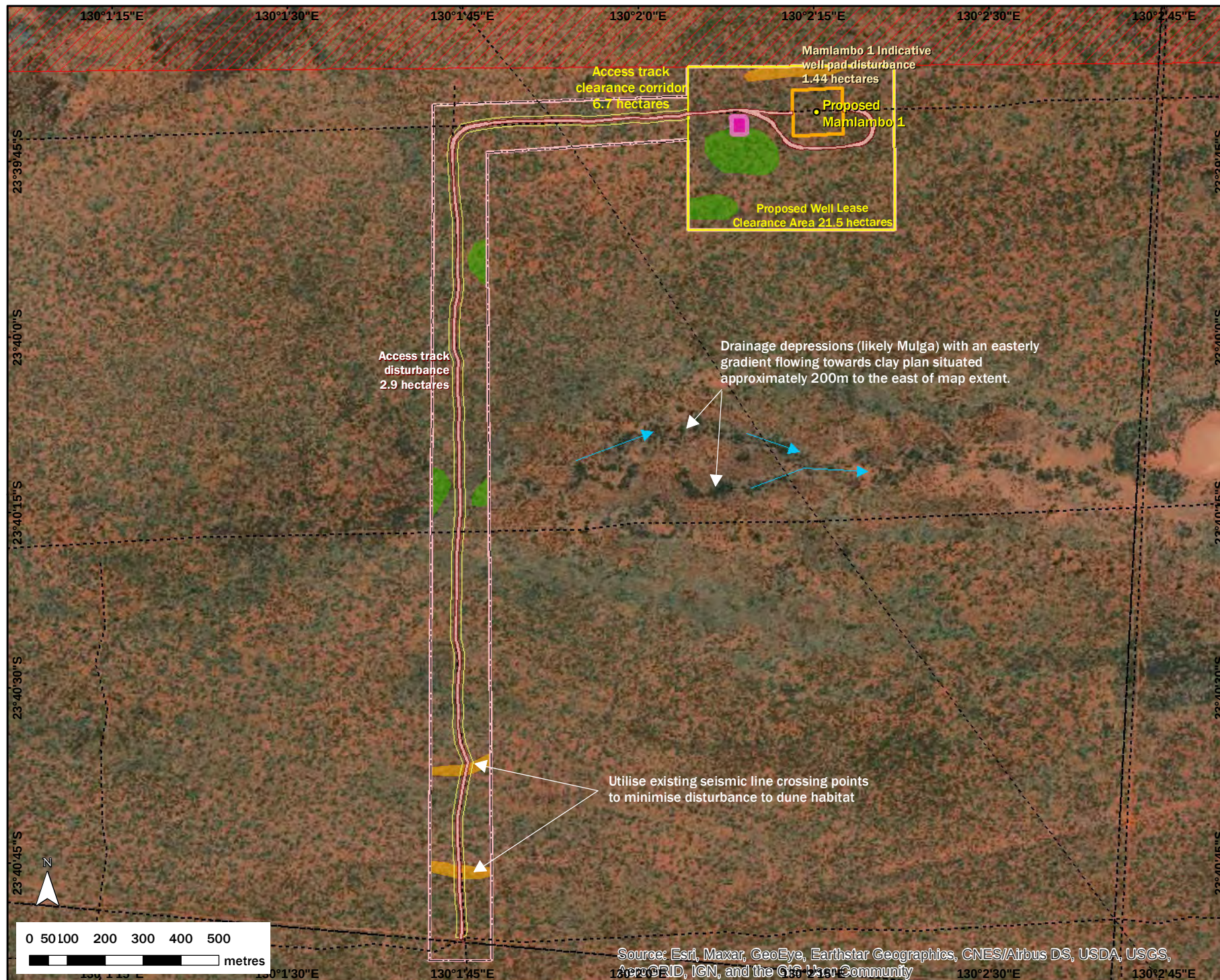


Figure 4-6 Mamlambo 1

- Indicative well location
- Heritage Exclusion Area
- Heritage Exclusion Area 10m buffer
- Proposed access disturbance area
- Indicative well pad disturbance
- Existing tracks or seismic lines
- Proposed Well Lease Clearance Area
- Proposed access corridors
- CLC SSCC zones
- Exclusion Zone
- Ecological survey area

Ecological values

Low sand dunes (land type M1-C); suitable habitat for Southern Marsupial Mole (threatened species) (low likelihood of occurrence)

Mulga and Ironwood depressions (land type M1-B); drainage feature (low ecological significance, so no buffer proposed)

ID: 0523-202
Rev: 8
Date: 23/10/2020

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4.2 Proposed Timetable and Associated Workforce

The civil construction and drilling components of the campaign are expected to commence in Quarter 4, 2020 with each well taking approximately four months to construct. CP plans to construct the seven wells within the timeframe of the EMP approval (5 years). The Minister will be notified that construction and drilling activities are to commence under Schedule 1, Item 12 of the Petroleum (environment) Regulation 2016 for each well.

Table 4-2 provides a preliminary timing of the campaign and the workforce required to complete the activities. It is important to note these are the total personnel to support the activities, the workforce will fluctuate on site as not all activities will be undertaken simultaneously. In addition, the works will be carried out as a campaign, so the workforce will be actively moving from well to well.

The workforce for civils, surface infrastructure installation and rehabilitation works will be locally sourced. These activities will likely be undertaken on a 2 weeks on and 1 week off roster working 12 hours a day. The drilling crews will most likely fly in fly out or drive in drive out to Alice Springs. The crews will be on a 2 weeks on and 2 weeks off rotation, with 2 crews on at a time to support 24 hour a day operations.

Civil activities will be undertaken from the hours of 6am to 6pm and drilling and completion activities will be undertaken 24 hours a day.

Table 4-2 Proposed Timing and Associated Workforce

Well Location	Activity	Estimated Duration	Workforce*
Dingo	Civil works	Dingo-1 ST1 – 7 days Dingo-5 – 14 days	5-7 personnel including: - Equipment operators - Surveyors - Site supervisor
	Drilling	Dingo-1 ST1 – 45 days Dingo-5 – 64 days	48-70 personnel including: - Drilling crew - Service companies crews - CP Onsite Company Representative (OCR)
	Wellsite production equipment and safety systems installation and commissioning	30 days per well	10 personnel including: - Welders & pipe fitters - Equipment operators - Site supervisor
	Rehabilitation	Dingo-1 ST1 – 14 days plus ongoing monitoring as per Rehabilitation Plan Dingo-5 – 14 days plus ongoing monitoring as per Rehabilitation Plan	3-5 persons including: - Equipment operators - Surveyors - Site supervisor
Orange-3	Civil works	14 days	5-7 personnel including: - Equipment operators - Surveyors - Site supervisor
	Drilling	62 days	48-70 personnel including: - Drilling crew - Service companies crews - CP OCR

Well Location	Activity	Estimated Duration	Workforce*
	Rehabilitation	14 days plus ongoing monitoring as per Rehabilitation Plan	3-5 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
Palm Valley-12	Civil works	14 days	5-10 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
	Drilling	86 days	48-70 personnel including: ▪ Drilling crew ▪ Service companies crews ▪ CP OCR
	Wellsite production equipment and safety systems installation and commissioning	30 days	10 personnel including: ▪ Welders & pipe fitters ▪ Equipment operators ▪ Site supervisor
	Rehabilitation	15 days plus ongoing monitoring as per Rehabilitation Plan	3-5 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
West Mereenie	Civil works	West Mereenie-27 – 14 days West Mereenie-28 - 14 days	5-7 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
	Drilling	West Mereenie-27 – 30 days West Mereenie-28 - 30 days	45-70 personnel including: ▪ Drilling crew ▪ Service companies crews ▪ CP OCR
	Wellsite production equipment and safety systems installation and commissioning	30 days	10 personnel including: ▪ Welders & pipe fitters ▪ Equipment operators ▪ Site supervisor
	Rehabilitation	30 days plus ongoing monitoring as per Rehabilitation Plan	3-5 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
Mamlambo-1	Civil works	14 days	5-7 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor
	Drilling	28 days	38-45 personnel including: ▪ Drilling crew ▪ Service companies crews ▪ CP OCR
	Monitor decommissioning & decommissioning	180 days	2 CP Operators

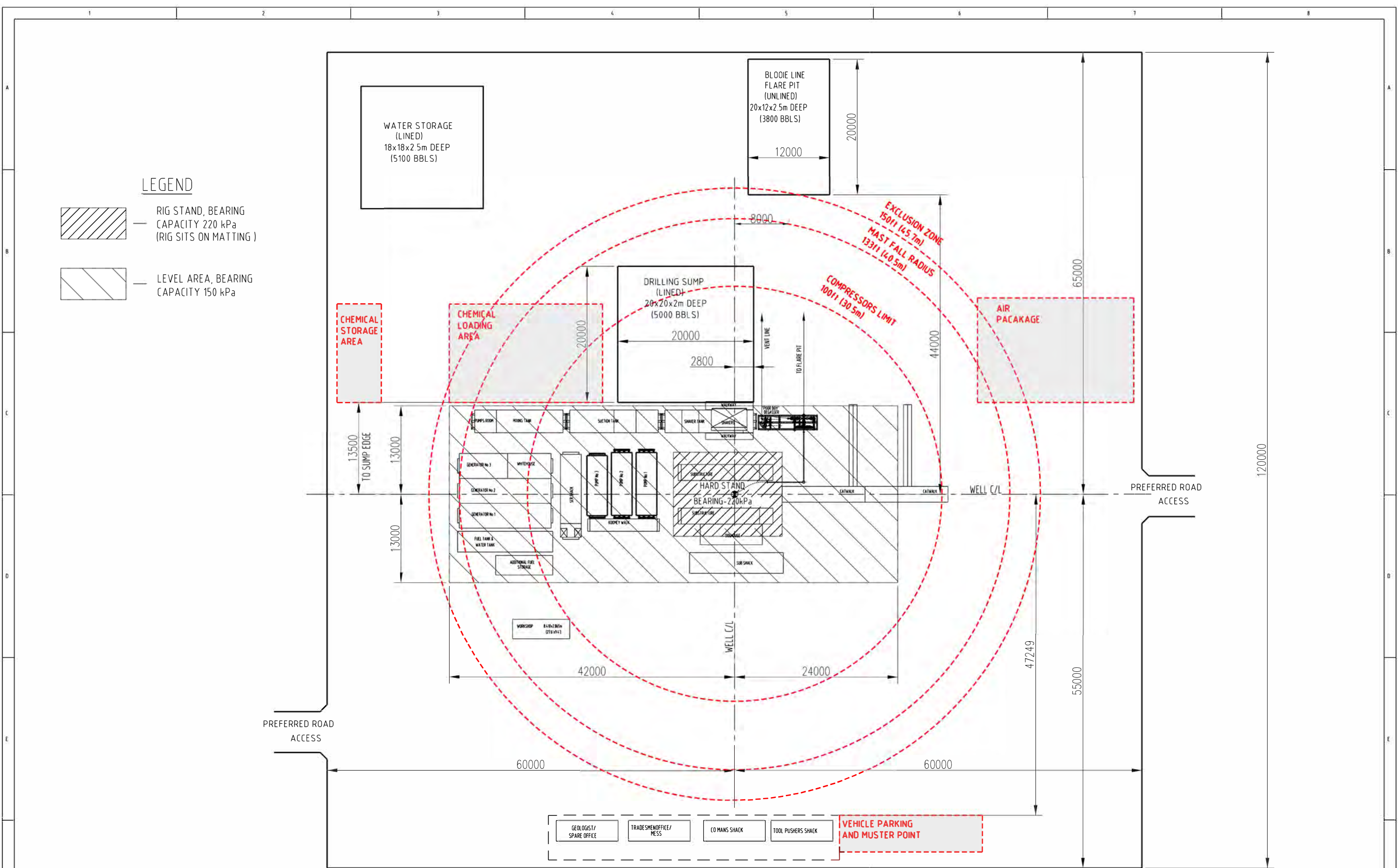
Well Location	Activity	Estimated Duration	Workforce*
	Rehabilitation	20 days plus ongoing monitoring as per Rehabilitation Plan	3 personnel including: ▪ Equipment operators ▪ Surveyors ▪ Site supervisor

*The workforce will fluctuate during the course of the activities on site.

4.3 Civil works

The civil works required to support the drilling campaign includes:

- Construction of access tracks to the well leases as outlined in Figure 4-1 to Figure 4-6 Width of the access track will be up to 8 m dependent upon the constraints at each location. Passing turnouts will be located intermittently along the track so that vehicles can safely pass each other. The turnouts will be located in areas with no constraints.
- Construction of well leases at each location (refer Figure 4-7 for the typical lease layout) which includes:
 - Well lease disturbance area to a maximum of 3 ha (is required for all wells with the exception of Mamlambo. Mamlambo will be drilled with a smaller drilling rig, which can be accommodated on a 1.5ha lease. The risk assessments have considered both the 1.5 ha and 3 ha disturbance area
 - Hardstand areas
 - Lined drill sump and water storage pit as per the CoP C4.12(b) (lined with an impermeable membrane with coefficient of permeability of less than 10^{-9} m/s tested in accordance with Australian Standard 1289.6.7.2 and with resistance to tearing >0.5 kN (Active Standard Test Method D 4073); static puncture >0.5 kN (Active Standard Test Method D 4833) and tensile strength >20 kN/m (Active Standard Test Method D 7275)
 - Flare pit
 - Cellar to house the well head and blow out preventer (BOP)
 - Installation of temporary fencing around sumps and pits
 - Installation of a fence around the well when there is no drilling rig on lease
 - Installation of signage at well leases
- Establishment of a temporary camp on previously disturbed land or within the well lease clearance area– refer Figure 4-8 for typical camp layout. Each campsite will be designed to cater for up to 70 people. For the Mereenie wells and the Palm Valley-12 well people may also be accommodated in the existing field operational camps
- Temporary fencing for an effluent irrigation area within the well lease clearance area
- Installation of sediment and erosion controls
- Regrading of existing campsites where required
- Extraction of sand / gravel from within the well lease clearance area to support construction activities (where insufficient quantities are available on site, it will be sourced from external suppliers. For the West Mereenie wells gravel and sand will be sourced from approved borrow pits within the Mereenie Field).



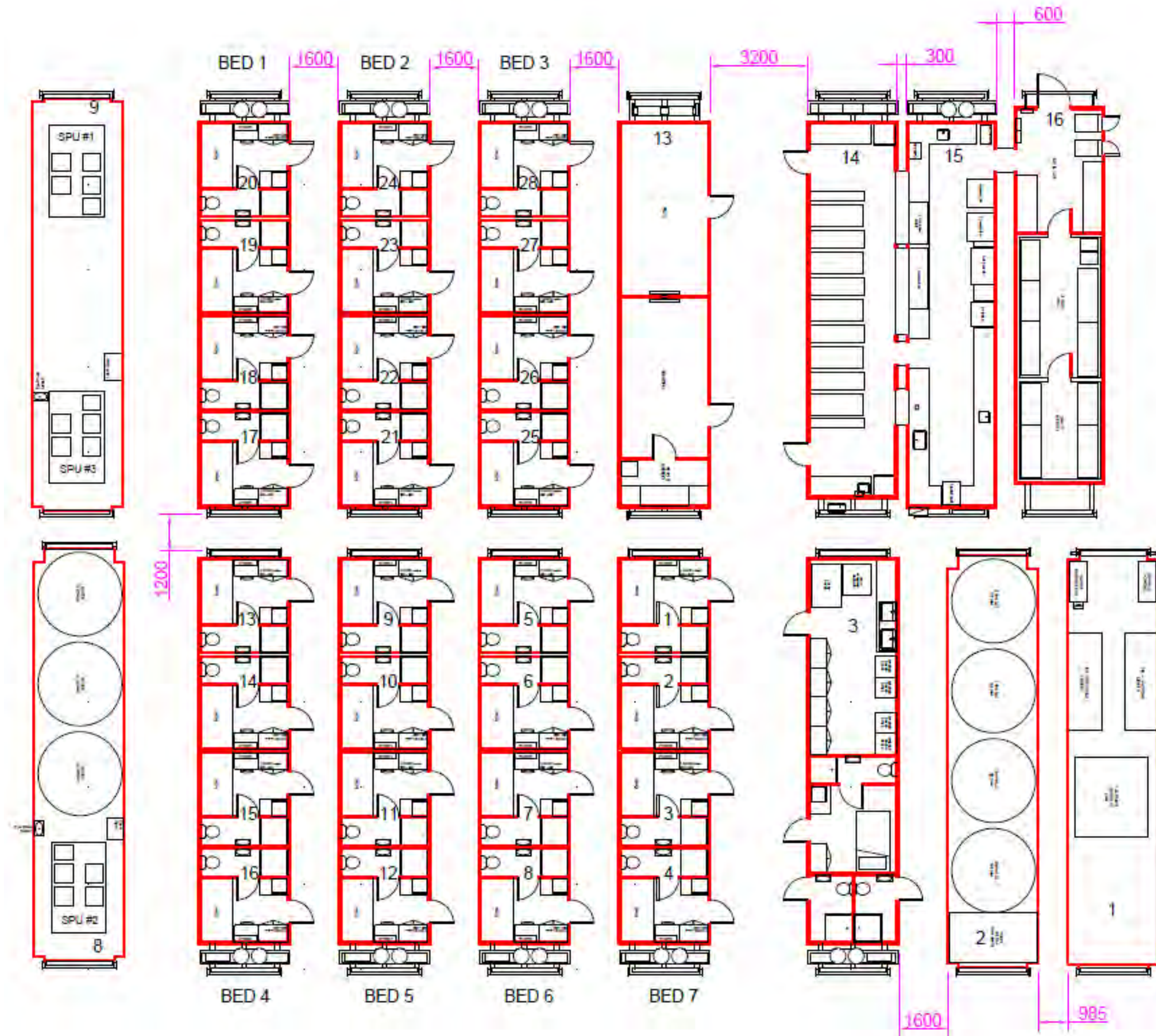


Figure 4-8 Typical Camp Layout

4.4 Drilling and Completion

All wells will be constructed to meet the requirements of the Code of Practice – Onshore Petroleum activities and in accordance with an approved Well Operations Management Plan (WOMP).

4.4.1 Dingo-1 ST1 Well

This activity will side track and deepen the existing Dingo-1 well creating the combined Dingo-1 ST1 well. Currently the Dingo-1 well is suspended consisting of a cement plug set within the 7" production casing at a depth of 2,166m.

The drill rig will be set-up over the existing wellhead. The BOP will be installed, and function/pressure tested. The existing 7" production casing will be cut at a depth of approximately 1,543 m. The section of 7" casing cut will be removed from the wellbore and a cement plug will be placed within the 7" casing over the top of the casing cut depth.

An open hole whipstock will be run in hole and the hole will be side tracked through the 12-1/4" open hole using a water-based mud system. Drilling will continue with a water-based mud system to a depth below the Chandler Salt Formation. A high strength casing will be run and cemented to surface. The high strength casing is designed to withstand the increased pressure the casing will experience due to the salt formation (collapse pressure).

Prior to drilling the production hole, a Formation Integrity Test (FIT) or Leak off Test (LOT) will be conducted below the Intermediate casing shoe. The FIT/LOT test confirms that the formation directly below the intermediate casing shoe will not breakdown during a well control event.

The production hole will be drilled initially with a water-based mud system and switched to an air/mist drilling fluid prior to drilling through the primary target, the Arumbera A1 formation. Air/mist drilling techniques will continue to target depth to avoid potential formation damage that can occur when using mud-based systems. Flow tests may be conducted during the drilling of the production hole to test potential gas flow rates within the Arumbera, Pioneer, and Areyonga formations. This process involves a controlled release/flow of hydrocarbon (dry gas) diverted to a flare pit for combustion.

Logging operations will be completed within the open hole section which involves electrically powered tools being run over the production hole where continuous measurements of the formation properties will be conducted to gather further information regarding the formation characteristics. Cement bond log(s) will be run over the relevant casing string(s) to confirm the cement integrity/bond over the casing.

Following logging operations; further formation testing maybe completed to measure reservoir parameters, reservoir fluids, flow rates; including Drill Stem Tests (DST) and/or Modular Formation Dynamic Test (MDT), over the Arumbera, Pioneer, and Areyonga formations.

The well will then be either completed and suspended pending connection to the existing network or decommissioned. If being completed and suspended, the well will consist of an "open hole completion" (not requiring any perforating activities). Completion activities will include:

- Installation of a production tubing string and production packer
- Installation of a minimum of two barriers for suspension: The well will be secured with the installation of plugs within the tubing string and wellhead.

4.4.2 Dingo-5 / Orange-3 Wells

The drill rig will be setup over the excavated cellar. A shallow conductor pipe will be installed either by pilling/auger methods or drilling with a water-based mud system. The conductor pipe will be set and cemented within a competent formation isolating the unconsolidated surface sediment. A second

deeper conductor string will be installed across the potential shallower fresh-water aquifer. The conductor casing will be set in a competent formation and cemented to surface.

The deep conductor hole section will be drilled with a water-based mud system.

Following the installation of the deep set conductor, the surface hole will be drilled using a water-based mud system similar to the mud system in the previous hole section. Surface casing will be run and cemented in place isolating any potential water aquifer.

Following the installation of the surface casing the BOP will be installed, and function/pressure tested. A FIT or LOT will be conducted prior to drilling below the surface casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT/LOT test confirms that the formation directly below the surface casing shoe will not breakdown during a well control event.

Drilling of the intermediate hole section will involve using a water-based mud system to a depth below the Chandler Salt Formation. A high strength casing will be run and cemented to surface. The high strength casing is designed to withstand the increased pressure the casing will experience due to the salt formation (collapse pressure).

Prior to drilling the production hole, a FIT or LOT will be conducted below the intermediate casing shoe. The FIT/LOT test confirms that the formation directly below the intermediate casing shoe will not breakdown during a well control event.

The production hole will be directionally drilled using direct circulation air/mist drilling techniques. The section will be drilled by building an angle to 45 degrees as the Arumbera A1 formation is intersected. Air/mist drilling operations will then continue at a 45-degree angle to target depth. Air/mist drilling techniques will be used within the Arumbera, Pioneer, and Areyonga to avoid potential formation damage that can occur when using mud based systems.

Flow tests may be conducted during the drilling of the production hole to test potential gas flow rates within the Arumbera, Pioneer, and Areyonga formations. This process involves a controlled release/flow of hydrocarbon (dry gas) diverted to a flare pit for combustion.

Logging operations will be completed within the open hole section which involves electrically powered tools being run over the production hole where continuous measurements of the formation properties will be conducted to gather further information regarding the formation characteristics. Cement bond log(s) will be run over the relevant casing string(s) to confirm the cement integrity/bond over the casing.

Following logging operations; further formation testing maybe completed to measure reservoir parameters, reservoir fluids, flow rates; including DST and/or MDT over the Arumbera, Pioneer, and Areyonga formations.

The well will then be either completed and suspended pending connection to the existing network¹ or decommissioned. If being completed and suspended, the well will consist of an “open hole completion” (not requiring any perforating activities). Completion activities will include:

- Installation of a production tubing string and production packer
- Installation of a minimum of two barriers for suspension: The well will be secured with the installation of plugs within the tubing string and wellhead.

4.4.3 Palm Valley-12 Well

The drill rig will be setup over the excavated cellar. A shallow conductor pipe will be installed either by pilling/auger methods or drilling with a water-based mud system. The conductor pipe will be set

¹ For the Orange-3 well connection to the existing network does not form part of this EMP. If a decision is made to connect the Orange-3 well to the network a separate EMP will be provided to DEPWS

and cemented within a competent formation isolating the unconsolidated surface sediment. A second deep set conductor string will be installed across the potential shallower fresh-water aquifer. The conductor casing will be set in a competent formation and cemented to surface.

The deep set conductor hole section will be drilled with a water-based mud system. Following the installation of the deep set conductor, the surface hole will be drilled using a water-based mud system similar to the mud system in the previous hole section. Surface casing will be run and cemented in place isolating any potential water aquifer.

Following the installation of the surface casing the BOP will be installed, and function/pressure tested. A FIT or LOT will be conducted prior to drilling below the surface casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT/LOT test confirms that the formation directly below the surface casing shoe will not breakdown during a well control event.

Drilling of the intermediate hole section will involve using a water-based mud system to a depth below the Chandler Salt Formation. A high strength casing liner will be run. The liner hanger assembly will be set at a depth within the previous casing string that will supply additional casing coverage over a potential water aquifer. A cement bond log will be run measuring the cement integrity behind the Liner.

Prior to drilling the production hole, a FIT or LOT will be conducted below the intermediate liner shoe. The FIT/LOT confirms that the formation directly below the intermediate casing shoe will not breakdown during a well control event.

The production hole will be directionally drilled using direct circulation air/mist drilling techniques. The section will be drilled by building an angle to 45 degrees as the Arumbera A1 formation is intersected. Air/mist drilling operations will then continue at a 45-degree angle to target depth. Air/mist drilling techniques will be used within the Arumbera formation to avoid potential formation damage that can occur when using mud-based systems.

Flow tests may be conducted during the drilling of the production hole to test potential gas flow rates. This process involves a controlled release/flow of hydrocarbon (dry gas) diverted to a flare pit for combustion.

If gas flow rates from the Arumbera formation are satisfactory the well will be set-up for future completion operations by setting a wireline set packer within the liner. If gas flows are deemed unsatisfactory the Arumbera formation will be plugged off with cement plugs.

Within the same wellbore; a cased hole whipstock will be set within the liner and the well will be side tracked while building an angle until the Pacoota formation is intersected horizontally. Drilling will continue horizontally using direct circulation air/mist drilling techniques. Flow tests may be conducted during the drilling of the production hole to test potential gas flow rates. This process involves a controlled release/flow of hydrocarbon (gas) diverted to a flare pit for combustion.

If minimal to no hydrocarbons are observed while drilling within the Arumbera and Pacoota formations, logging operations will be completed within the open hole section which involves electrically powered tools being run over the production hole where continuous measurements of the formation properties will be conducted to gather further information regarding the formation characteristics. Cement bond log(s) will be run over the relevant casing string(s) to confirm the cement integrity/bond over the casing.

If gas flow rates to surface are satisfactory, the well will be completed as a production well. The well will be an "open hole completion" (not requiring any perforating activities). Completion activities will include:

- Installation of a production tubing string and production packer
- Installation of wellhead assembly enabling the well to safely flow gas to surface.

4.4.4 Mamlambo-1 Well

Mamlambo-1 well is a crude oil exploration well for the purpose of determining the presence of an active hydrocarbon system.

The drill rig will be setup over the excavated cellar. A conductor pipe will be installed either by pilling/auger methods or drilling with a water-based mud system. The conductor pipe will be set and cemented within a competent formation isolating the unconsolidated surface sediment.

The surface hole section will be drilled with a water-based mud system. A surface casing string will then be run and cemented to surface within a competent formation isolating any potential shallower fresh-water aquifer. Following the installation of the surface casing the BOP will be installed, and function/pressure tested.

A FIT or LOT will be conducted prior to drilling below the surface casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT/LOT test confirms that the formation directly below the surface casing shoe will not breakdown during a well control event.

The intermediate hole will be drilled using a water-based mud system similar to the mud system in the previous hole section. Intermediate casing will be run and cemented in place isolating the Mereenie or any other aquifer. A FIT or LOT will be conducted prior to drilling below the intermediate casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT/LOT test confirms that the formation directly below the intermediate casing shoe will not breakdown during a well control event.

The production hole will be drilled and cored using a water-based mud system to target depth. Wireline retrievable coring operations will be conducted within the Lower Stairway and Pacoota formations.

Logging operations will be completed within the open hole section which involves electrically powered tools being run over the production hole where continuous measurements of the formation properties will be conducted to gather further information regarding the formation characteristics. Cement bond log(s) will be run over the relevant casing string(s) to confirm the cement integrity/bond over the casing.

Following logging operations; further formation testing maybe completed to measure reservoir parameters, reservoir fluids, flow rates; including DST and/or MDT, over the Lower Stairway and Pacoota formations. It is not planned that oil will be produced to surface during testing, but contingencies will be put in place to manage the volume of the casing string –5bbls. A tank will be on site for the collection of any unplanned oil that is produced to surface and will comply with A3.8 of the Code of Practice for containment of any oil produced to surface. In addition, if any oil is produced to surface it will be transported to the Mereenie Facility for processing.

Mamlambo-1 well will then be decommissioned in accordance as per the Section 4.6.

4.4.5 West Mereenie-27 & 28 Wells

Both wells will be drilled using the same technique. For each well, the drill rig will be setup over the excavated cellar. A conductor pipe will be installed either by pilling/auger methods or drilling with a water-based mud system. The conductor pipe will be set and cemented within a competent formation isolating the unconsolidated surface sediment.

A 17 ½" hole will then be drilled from the base of the conductor through the fresh water Mereenie aquifer and a second conductor string will be installed across the potential shallower freshwater aquifer. The conductor casing will be set in a competent formation and cemented from the base of the casing to surface.

The conductor hole will be drilled with a water-based mud system. The water-based mud will consist of additives for fluid density, filtration control, viscosifiers, hole stability, pH control, and loss control material may be used. This conductor string will be pressure tested.

Following the installation of the second conductor, the 12 ¼" surface hole will be drilled using a water-based mud system similar to the mud system in the previous hole section vertically through a potential second saltwater aquifer. A competent formation will then be found and then the surface casing will be run and cemented in place isolating any potential water aquifer. Noting at this point the Mereenie aquifer will now be isolated by two strings of steel casing, conductor and two cement columns.

Following the installation of the surface casing; the BOP will be installed, and function/pressure tested. Prior to drilling out the surface casing shoe a pressure test is conducted on the surface casing to ensure its integrity. A cement bond log will be performed. This ensures that the integrity of the casing and the cement can be verified.

Once the casing shoe is drilled out a FIT or LOT will be conducted prior to drilling below the surface casing to determine the strength and integrity of the open hole formation below the casing shoe. The FIT/LOT confirms that the formation directly below the surface casing shoe will not breakdown during a well control event.

Drilling of the intermediate 8 ½" hole section will be done using a directional drilling assembly to deviate the hole from vertical to an angle of 45 degrees from vertical. The drilling will also involve using a water-based mud drilling fluid to a depth where the Horn Valley Siltstone is encountered. This siltstone acts as a regional seal and is a good formation to have the intermediate casing shoe. At this stage an intermediate casing liner (string) will be run on a liner hanger and this will be secured within the intermediate casing string. The liner will be cemented from the shoe to the liner hanger. The hanger and the casing are pressure tested and a second cement bond log is run to verify the integrity of the liner, cement and sealing assemblies.

Prior to drilling the production hole, a FIT or LOT will be conducted below the intermediate casing shoe. The FIT/LOT confirms that the formation directly below the intermediate casing shoe will not breakdown during a well control event.

The production hole will be directionally drilled using direct circulation air/mist drilling techniques. The section will be drilled to maintain the 45-degree hole angle as the primary targets the Pacoota Sandstones are intersected. Air/mist drilling operations will then continue at a 45-degree angle to target depth. Air/mist drilling techniques will be used within the Stairway group to avoid potential formation damage from the invasion of drilling fluid (when mud drilling).

The well will be fully underbalanced and as a result any gas encountered will be immediately brought to surface where it will be flared at the end of the blooie line. All gas rates (both compressed air in and the flow rates out) will be measured during the drilling of the production hole. If there is more coming out than in, this indicates gas is flowing to surface and this will be measured prior to the flare. At various intervals the gas flow rates are measured to verify the success of the well. This process involves a controlled release/flow of hydrocarbon (dry gas) diverted to a flare pit for combustion.

Following the results obtained from flow tests (if applicable), a decision will be made to either run a completion or to decommission the well.

4.4.6 Drill Cuttings

The drilling of each well will utilise both water-based mud systems and/or a compressed air and mist drilling fluid.

During mud drilling operations the drilling fluid is re-circulated down the drill pipe returning up the hole bringing drill cuttings to surface. The separation of the cuttings and the drill fluid occurs by flowing and passing over/through solids control equipment at the surface. The cuttings will be directed into

the drill sump which will have a capacity of approximately 5,000 bbls (0.8 ML) and drilling fluid is returned to the closed loop mud tank system for reuse.

During air and mist drilling operations all the cuttings will be directed through a blooie line to the flare pit which will have a capacity of approximately 0.6 ML. A de-duster will be installed on the blooie line. This device will wet the air stream as the cuttings exit the blooie line, minimizing dust output.

The total estimated volume of cuttings removed during the drilling operations of each well (mud and air drilling) will range between 0.07 ML to 0.5 ML due to the difference in depths of each well. When drilling and associated activities have been completed on the site, the lined sumps (drill sump) and flare pit are left to dry out. The dried cuttings from the flare pit are transferred to the lined drill sump before both the sump and flare pit are backfilled, provided post analysis confirms the material is suitable for in-site disposal.

Baseline soil samples of the drill sump will be taken. Liquids in the drill sump will also be sampled and the final residual drill cuttings will also be tested with test results sent to DEPWS from an independent suitably qualified third party confirming that in-situ burial is acceptable.

Where the in-situ burial is not acceptable then the material will be transported to an appropriately licensed facility.

The drill sump will remain open until the liquid in the sump has sufficiently evaporated. CP's previous experience for wells in this part of the NT is that it can take up to 24 months for this evaporation to occur. The sump will be designed to cater for the 0.1% Annual Exceedance Probability (AEP)² rainfall event (refer to Sections 7.4.6 and 7.4.7) and will be monitored as per the monitoring program in Section 9.5.

In-situ burial of drilling cuttings where appropriate quality criteria can be met is considered to represent an acceptable and low as reasonably practical environmental risk when considered holistically. The cuttings will be mixed with the subsoil and buried beneath more than one metre of soil. The topsoil will be restored over the area and revegetated.

4.5 Wellsite Production Equipment and Safety Systems

For the Dingo wells, Palm Valley-12 well and West Mereenie wells that are completed, wellsite production equipment and safety systems will be installed to allow the well to be connected to the existing gas collection network for processing before transfer to market. Activities undertaken as part of the wellsite production equipment and safety systems installation process include:

- Tie-in to the wellhead, installation of monitoring instruments, control valves and shutdown skids within the existing disturbance footprint of the well lease. Figure 4-9 shows the typical wellsite production equipment and safety systems layout for a gas well
- Installation of new flowlines to connect the wellsite production equipment, safety systems and wellhead to existing flowlines (Figure 4-9 shows the typical above ground flowline installation). The new flowline will be a combination of below ground and above ground as follows:
 - Dingo wells – below ground (noting that the pipework will either be from Dingo-5 well or Dingo-1 ST1 well dependent upon which well is drilled)
 - Palm Valley-12 well – above ground
 - West Mereenie wells – above ground
- Installation of flowlines will be undertaken in accordance with Australian Standard 2885.0:2018 Pipelines – Gas and liquid petroleum - General requirements.

² The 0.1% AEP rainfall event is the equivalent of a 1:1000 rainfall event



Figure 4-9 Typical Well Lease Layout and Above Ground Flowline

4.6 Decommissioning

Where a well is to be decommissioned, the activities will be done in accordance with the principals of the Code of Practice (CoP) section B.4.15.1 and specifically the mandatory sections B.4.15.2 and B.4.15.3. Further the decommissioning of a well is a regulated activity and this activity will be in an approved Well Operations Management plan that will be approved by DITT.

As per the CoP, the two stage decommissioning process per table 4 of section B.4.15.1 will be followed with well integrity maintained as per section B.4.1, all aquifers will be isolated from each other and the surface by a minimum of one well barrier and from any permeable hydrocarbon bearing zones by a minimum of two well barriers.

The open hole section will be placed to provide cement coverage extending from at least 50 m below the base of, to at least 100 m above the top of, any hydrocarbon bearing zone or aquifer and between permeable zones of different pressure regimes or salinity.

For any cased hole section the cement plug(s) will be placed adjacent to good annulus cement and provide cement coverage at least 50m below the base of, to at least 50 m above the top of, any hydrocarbon bearing zone or aquifer and between permeable zones of different pressure regimes or salinity

A cement plug will be placed to provide cement coverage at least 50 m above and 50 m below the casing shoe.

A surface cement plug will extend 15m below the surface to 50 m below the base of the deepest aquifer and placed in the innermost string of casing that extends to the surface. Following the surface

cement plug the wellhead will be removed and the casing will be cut 1.5m below ground and covered with a minimum of 30cm of cement.

The cement plugs discussed above will be permanently placed in the well and verified as follows;

- Off bottom open hole cement plugs will be verified by tagging the plug with a minimum 2270 kg (5000 lb) drill string weight
- For consecutive stacked cement plugs with the first plug set on bottom or solid base (e.g. mechanical packer, other verified cement plug) validation of the top of good quality cement will be carried out by tagging the top plug with a minimum 2270 kg (5000 lb) drill string weight. If using a sacrificial stinger to set open hole plugs, no tag is necessary where no losses are observed during cement placement
- For a cased hole cement plug with the bottom of the plug exposed to open hole validation will be done by tagging the top plug with a minimum 2270 kg (5000 lb) drill string weight and by pressure testing to 3.5 MPa (500 psi) above the estimated (or previously recorded) leak-off pressure (within the limits of the casing and wellhead pressure ratings)
- For a cased hole cement plug supported by a pressure tested bridge plug, validation may be by post cement job report and calculations, or by tagging the plug with a minimum 2270 kg (5000 lb) drill string weight
- For an unsupported cased hole cement plug barrier not exposed to open hole below, validation will be done by tagging the plug with a minimum 2270 kg (5000 lb) drill string weight
- When a sacrificial string is used to place a cement plug, validation may be via a combination of pressure testing to confirm isolation and validation of the conduct of the cement job

Before the wellhead is removed monitoring of the well will be undertaken as per the DITT approved WOMP to verify the well, barriers and the decommissioning integrity will be confirmed. Once confirmed the Wellheads will be removed, the final cement plug placed as per section B.4.15.2 will be placed and the casing will be cut 1.5m below ground level.

A steel marker plate cut from corrosion resistant alloy or similar grade steel for corrosive environments will be installed after the wellhead has been cut off detailing the following:

- the identifying name of the well;
- the total depth in metres of the well;
- the date the well was decommissioned; and
- the marker plate shall be covered with soil to ground level.

Complete and accurate records of the entire decommissioning procedure will be kept and submitted as part of the legislative reporting requirements for the decommissioning of petroleum wells.

The potential for accumulation of NORM in well equipment will be assessed and appropriate measures put in place to reduce risks to the health and safety of people and the environment.

Leases and roads will be rehabilitated as per the rehabilitation plan in Section 7.8.

4.7 Rehabilitation

Rehabilitation of decommissioned wells will be undertaken in accordance with the rehabilitation management plan in Section 7.8.

For wells that are completed, the ongoing production operation of the wells will be undertaken under the applicable Field Environment Management Plan (FEMP) with rehabilitation of the operational well undertaken in accordance with that plan. Amendments to these plans are likely to be required to include the additional wells. Once the well has been transferred to operation under the relevant FEMP, all obligations for the well will also be transferred and the drilling EMP closed out.

Existing (FEMP)s are:

- Palm Valley – Palm Valley Gas Field, (FEMP) 2019
- Mereenie – Mereenie Oil and Gas Field, (FEMP) 2017
- Dingo – Dingo and Surprise (FEMP) 2020

Orange-5, depending on the results of the testing, will be cased and suspended for future production or decommissioned and rehabilitated under this EMP. Mamlambo-1 well is an exploration well, therefore, it will be decommissioned and rehabilitated after testing is complete, under this EMP.

4.8 Support Activities

4.8.1 Flaring

Gas flaring will occur during the drilling of Palm Valley 12, Orange 3, Dingo 1, Dingo 5 and West Mereenie 27 and West Mereenie 28, noting that Mamlambo 1 is a crude oil well and no flaring will occur.

Gas that is extracted during the drilling activities will typically be diverted to the in-ground horizontal flare pit for combustion. Flaring may occur intermittently throughout the wellsite occupation depending on the activity being conducted, however the main time when the flare will be active is during the drilling of the production holes into the target formations where the flare may be continuously active for 10-75 hours at a time, depending on the well being drilled.

Flaring may occur during other activities such as flow testing and setting of production packers, though these are of a relatively short duration compared to the drilling of the production holes.

The estimated total duration of flaring (calculated based on the duration of drilling of production holes and other activities in which gas will be flared) and the total volume of gas to be flared at each well is shown in Table 4-3. The total volume of gas to be flared at each well has been calculated using the maximum forecast gas production rates for the well, multiplied by the total duration of the flare gas-generating activity.

Table 4-3 Estimated Total Flare Duration and Total Gas Flare Volumes

Well Name	Estimated total duration of flaring (days)	Estimated (maximum) total volume of gas to be flared (Bcf)
Palm Valley-12	20	0.319
Orange-3	15.8	0.267
Dingo – 1ST	9.2	0.151
Dingo-5	15.9	0.301
West Mereenie-27	3.9	0.019
West Mereenie-28	3.9	0.019
TOTAL	68.7	1.076

In line with Bushfire Northern Territory requirements, a permit will be obtained prior to conducting any flaring during a high fire danger period.

All flaring activities will be stipulated in the applicable WOMP for the well and approved by the DITT. Central Petroleum and drilling contractor have determined a combustion efficiency of 98% for the blooie line flare in an open-air environment. The efficiency of the open-ended flare is modelled on the Flare Efficiency study by McDaniel (1983) commissioned by the US EPA to study the efficiencies of flares as devices for the disposal of hydrocarbon emissions. This study determined the combustion efficiencies in the flare plume are greater than 98%.

4.8.2 Camp

The accommodation camps will be located on site away from communities and have a capacity to accommodate up to 70 people. The camp is sized to be able to accommodate for the multiple activities that will be underway simultaneously as part of the campaign (refer to Table 4-2 for workforce numbers). The camp will be registered and will be equipped with a fully self-contained sewage treatment plant furnished with an irrigation sprinkler system.

The camps small sewage sullage treatment systems and reuse of sewage effluent will be managed in compliance with the *Code of Practice for on-site Wastewater Management*, issued by the Department of Health.

4.8.3 Water Usage

Water required to support the drilling program will be sourced from either existing CP groundwater bores or under commercial arrangements with local suppliers. Table 4-4 provides an estimated breakdown of water requirements for the various locations.

Table 4-4 Estimated Water Requirements

Location	Source	Civil (ML)	Drilling (ML)	Camp (ML)	Existing groundwater use by CP (ML/year)
Dingo-1 ST1 / Dingo-5	Commercial supplier	0.075	1.5	1.6	NA*
Orange-3	Commercial supplier	0.075	1.5	1.5	NA*
Palm Valley-12	Commercial supplier	0.08	1.8	2.1	NA*
West Mereenie-27	Bore – RN018955 Bore – RN017657	0.075	0.75	0.25	34.1-47.4 [†]
West Mereenie-28	Bore – RN017898 Bore – RN004620 Bore – RN013861	0.075	0.75	0.25	
Mamlambo-1	Bore – RN018851	0.06	0.6	0.75	

*NA = not applicable as water will be sourced via a commercial supplier rather than from a local groundwater bore

[†] In accordance with amendments to the Water Act (1992), CP has applied for a Water Extraction License for the Mereenie Oil and Gas Field for an annual volume of 52.8 ML. This volume includes water necessary for the drilling program. The range in values represents groundwater usage at the Mereenie field for 2017-2020 (EcOz, 2020).

As the above water bores are existing bores used by operations at the respective locations, CP will liaise with the Water Resources Division of DEPWS to assist in determining potential water licensing requirements.

The actual volumes of water used at each of the locations will be recorded and tracked (including if used for purposes in addition to that provided in Table 4-4, e.g. dust suppression). CP will also record daily estimates of volumes of water that evaporate from any tanks.

4.8.4 Waste Management

At each well lease and accommodation camp waste is initially separated into listed and non-listed wastes. Listed waste is any waste prescribed under the *Waste Management and Pollution Control (administration) Regulations 1998* as a listed waste (refer <https://ntepa.nt.gov.au/waste-pollution/approvals-licences/listed-waste/>), with non-listed waste being waste that is not prescribed under the legislation.

Listed and non-listed wastes are stored in vermin proof containers at each well lease and accommodation camp until it is collected and transported off site by a licensed contractor and disposed of at an appropriately licensed facility.

As part of the removal of any wastewater from each location (in addition to those requirements for being a licensed waste transporter) the following matters are to be recorded:

- Volume removed
- Destination
- Licence number of the waste transporter.

The tracking of wastewater must be done in an auditable chain of custody system and be in accordance with requirements imposed under the *Waste Management and Pollution Control Act 1998* and the *Radiation Protection Act 2004* (if applicable).

The typical wastes that are generated at each well lease and accommodation camp is listed in Table 4-5 .

Table 4-5 Waste type and disposal method

Typical waste	Disposal method
Sewage, grey water	Treatment Grey water and sewage treated and disposed of on-site in an approved, portable treatment system as per the Department of Health's, <i>Code of Practice for on-site Wastewater Management</i> Sludge is transported to an approved disposal facility
Food, paper, plastics	Disposal Stored in waste bins for transport and disposal at an approved disposal facility
Glass, cans, scrap metals	Recycling Stored in recycling bins for collection and transport to an approved recycling facility
Empty chemical, dangerous goods containers	Recycled / Disposed Stored in a secure area and either re-used on site, returned to supplier where possible, or transported and disposed at an approved disposal facility
Timber pallets	Recycled / Disposed Stored in a secure area and either re-used on site, returned to supplier where possible, or transported and disposed at an approved disposal facility
Batteries	Recycled Stored in a secure area for collection and transport to an approved recycling facility
Oily rags, oil-contaminated material, filters, greases and any other hydrocarbon containing material	Recycled / Disposed Stored in a secure area for collection and transport to an approved recycling facility or disposal facility
Used spill kit materials	Disposal Stored in a secure area for collection and transport to an approved disposal facility
Drill fluids / cuttings	Recycled / Treatment / Disposal Fluids segregated from muds and cuttings and reused. Remaining fluids / muds stored in lined sump / flare pit. Fluid evaporated. Solids tested and disposed either on or off site depending on results

Typical waste	Disposal method
Spill contaminated soil	Disposal Stored in waste bins for transport and disposal at an approved disposal facility
Cement returns	Disposed Stored in a secure area for collection and transport to an approved disposal facility
Raw water	Reuse Excess water at conclusion of drilling will be used for rehabilitation activities

4.8.5 Chemical³ Storage / Use

All chemicals used in Australia must be approved for use by the Commonwealth Government's Department of Health and be listed on the Australia Inventory of Chemical Substances which is maintained under the National Industrial Chemicals Notification and Assessment Scheme. The safety data sheets (SDS) for all chemicals to be used as part of the drilling campaign will be provided to DITT as part of the drilling applications and will be available on site.

In addition to the requirements under this EMP;

- All chemicals and waste generated during civil activities, drilling, and maintenance will be stored in designated areas with secondary containment
- All bunded areas used for storing chemicals will be compacted to reduce the permeability to be able to recover materials if a spill occurs
- Open sumps will have freeboard provision that comply with the NT Wastewater Code of Practice
- All transportation of chemicals will comply with the NT Dangerous Goods Act and associated legislation
- All contractors will be required to comply with the Spill Management Plan and have procedures in place to outline how spills will be prevented, identified and rectified
- Spill kits and emergency response measures will be deployed at site where chemicals are stored and handled
- Any spills will be cleaned up immediately in accordance with the Spill Management Plan.

4.8.5.1 Drilling Fluid

The proposed drilling fluid is comprised of predominantly water with the remaining made up of salts and fluid additives. A list of the potential chemicals used in the drilling fluids for this drilling campaign is provided in Table 4-6 . These drilling fluid chemicals are stored in an enclosed, purpose built, portable trailer, which keeps the chemicals dry and safe. The portable trailer is located in a designated chemical storage area within the well lease that is bunded and can contain greater than 100% of the largest container stored in the area plus 10%. The bunded area is compacted to reduce the permeability to be able to recover materials if a spill occurs. In addition, the bunded area will be designed to manage clean and dirty water, be compatible with the stored material and designed to avoid failure from operational activities.

Mixing of the drilling fluid chemicals occur within tanks which will have temporary spill absorbent mats placed under them to capture any spills which may occur.

No drilling fluid chemicals that are used in the process contain benzene, toluene, ethylbenzene and xylene (BTEX).

³ References to chemicals throughout this EMP include dangerous goods, hazardous substances, fuels, oils, lubricants, completion fluids and the like

It is not necessary to use all of the drilling fluid chemicals listed in Table 4-6 for each well as the chemicals required are determined by the particular conditions encountered during drilling. The primary chemicals to be used during the campaign are those that have an estimated quantity per well value in Table 4-6, with the other chemicals, the chemicals are available onsite and are used on a contingency basis if required during the drilling campaign. This provides CP with the maximum flexibility to manage the well and in addition minimises the movements of chemicals on the roads.

Table 4-6 Drilling Fluid

Product Name	Dangerous Good	Hazardous Substance	Estimated Quantity / well	Concentration (parts per billion)	Container Size / Type	Storage Location
AMC Biocide G	No	Yes	200 – 850 KL	0.1 - 0.5	20 L / Package	Well lease - CSA
AMC Defoamer S	No	No	1,100 – 3,300 KL	1.2	20 L / Package	Well lease - CSA
AMC Pac LV	No	No	1,250 – 6,700 Kg	0.5 - 4	25 Kg / Package	Well lease - CSA
AMC Ben	No	Yes	600 – 4,200 Kg	3	25 Kg / Package	Well lease - CSA
Caustic Soda	No	No	200 – 1,000 Kg	0.2 - 0.5	25 Kg / Package	Well lease - CSA
Hydro 327	No	No	150 – 550 KL	0.2	15 L / Package	Well lease - CSA
Potassium Chloride	No	No	7,200 – 35,000 Kg	7 - 17.5	25 Kg / Package	Well lease - CSA
Soda Ash	No	Yes	100 – 300 KL	0.1	25 Kg / Package	Well lease - CSA
Sodium Sulphite	No	No	640 - 3,400 Kg	0.1 - 1.25	25 Kg / Package	Well lease - CSA
Xan Bore	No	No	3,200 – 6,600 Kg	0.4 - 2.5	25 kg / Package	Well lease - CSA
Superfoam	No	No	1,300 – 12,100 KL	4.5	25 L / Package	Well lease - CSA
AMC Pac R	No	No	Contingency use only		25 Kg / Package	Well lease - CSA
AMC Rod-Free	No	Yes			25 Kg / Package	Well lease - CSA
AMC Shalehib Ultra	No	No			25 Kg / Package	Well lease - CSA
AMC Xtra-Sweep	No	No			5.5 Kg / Package	Well lease - CSA
AMC Det Xtra	No	No			25 Kg / Package	Well lease - CSA
AMC Resi-Drill	No	No			12 Kg / Package	Well lease - CSA
AMC Barite	No	Yes			25 Kg / Package	Well lease - CSA
AMC EP Bit Lube	No	No			25 L / Package	Well lease - CSA
AMC Quickseal Fine	No	No			18.2 Kg / Package	Well lease - CSA
AMC Quickseal Medium	No	No			18.2 Kg / Package	Well lease - CSA

Product Name	Dangerous Good	Hazardous Substance	Estimated Quantity / well	Concentration (parts per billion)	Container Size / Type	Storage Location
AMC Quickseal Coarse	No	No			18.2 Kg / Package	Well lease - CSA
AMC Lime	No	Yes			25 Kg / Package	Well lease - CSA
AMC Liqui-Sperse	No	No			25 L / Package	Well lease - CSA
Calcium Carbonate C	No	No			25 Kg / Package	Well lease - CSA
Calcium Carbonate F	No	No			25 Kg / Package	Well lease - CSA
Calcium Carbonate M	No	No			25 Kg / Package	Well lease - CSA
Calcium Chloride (74%)	No	Yes			25 Kg / Package	Well lease - CSA
Citric Acid	No	Yes			25 Kg / Package	Well lease - CSA
Hydro 3272	No	No			15 L / Package	Well lease - CSA
Portland Cement	No	Yes			20 Kg	Well lease - CSA
Sodium Acid Pyrophosphate	No	No			25 Kg	Well lease - CSA
Sodium Bicarbonate	No	No			25 Kg	Well lease - CSA
Sodium Chloride	No	No			25 Kg	Well lease - CSA
Spectra Cap	No	No			25 Kg	Well lease - CSA
Torq-Free Xtra	No	No			20 Kg / Package	Well lease - CSA

4.8.5.2 Completion Fluid

Completion fluid is comprised of predominantly water with the remaining made up of salts and fluid additives. A list of the potential chemicals used in the completion fluids for this drilling campaign is provided in Table 4-7 . These completion fluid chemicals are stored in a designated chemical storage area within the well lease that is bunded and can contain greater than 100% of the largest container stored in the area plus 10%. Mixing of the completion fluid chemicals occur within tanks on the well lease which will have temporary spill absorbent mats placed under them to capture any spills which may occur.

No completion fluid chemicals that are used in the process contain BTEX.

Table 4-7 Completion Fluids

Product Name	Dangerous Good	Hazardous Substance	Estimated Quantity / well	Concentration (parts per billion)	Container Size	Storage Location
AMC Biocide G	No	Yes	31 KL	0.02	20 L / Package	Well lease - Chemical storage area

Product Name	Dangerous Good	Hazardous Substance	Estimated Quantity / well	Concentration (parts per billion)	Container Size	Storage Location
Potassium Chloride	No	No	2,066 Kg	7.1	25 Kg / Package	Well lease - Chemical storage area

4.8.5.3 Other Chemicals

Table 4-8 provides a summary of the other chemicals that will be stored at each of the well leases during the drilling campaign.

Diesel will be stored in a double lined tank, whilst the other chemicals are stored in the workshop area of the well lease which is bunded and can contain greater than 100% of the largest container stored in it plus 10%.

The portable storage trailer is bunded and can contain greater than 100% of the largest container stored in it plus 10%. The portable storage trailer can be moved around the well lease to areas where the chemicals are required.

Table 4-8 Other Chemicals

Product Name	Dangerous Good	Hazardous Substance	Estimated Quantity	Container Size / Type	Storage Location
Hydraulic oil	No	Yes	200 L	5 -20 L / Package	Portable storage trailer
Engine oil	No	No	200 L	5 - 20 L / Package	Portable storage trailer
Transmission oil	No	No	200 L	5 – 20 L / Package	Portable storage trailer
Coolant	No	No	200 L	5 – 20 L / Package	Portable storage trailer
Degreasers	No	No	100 L	5 – 20 L / Package	Portable storage trailer
Diesel	Yes	Yes	110 – 550 KL	100 KL / Tank	Well lease - Tank
Pipe Dope	No	Yes	20 L	20 L / Package	Workshop
Brake cleaner	No	Yes	20 L	20 L / Package	Workshop
WD-40	No	Yes	20 L	1 L / Package	Workshop
Various spray paints	No	Yes	10 L	1 L / Package	Workshop

4.8.6 Traffic

The potential traffic related impacts associated with CP's 2020-21 drilling program, including civils activities, drilling, well testing and ongoing operations, is not considered to be significant. Traffic associated with exploration activities is generally small and of short duration.

The majority of equipment to be utilised at each proposed drilling location will be transported via internal private roads to access each gas/oil field once they turn off the primary and secondary State roads. There are no upgrades required to the State roads for the loads to turn off onto the access tracks. The drilling rig makes up most trucked loads and once the rig is onsite a minor increased traffic will be generated by consumables and staff movements.

The peak maximum anticipated traffic flow increase associated with CP's activities with each proposed drilling location (including civils, drilling, completions and commissioning) will be approximately 20 vehicles per day, with ~40% being heavy vehicles. Movements of civil related infrastructure are anticipated to be minor and will be sourced locally, with a peak of 5 vehicle movements (<20% heavy vehicles) for several days during equipment mobilisation and demobilisation (prior to the drilling rig mobilisation). Average daily traffic additions during the remainder of the project period are likely to be 10-15 movements per day for the first two weeks, reducing down to three-four movements for the remainder of the period once the wells undergo testing and increasing as the rig demobilises to the next location. It is expected that 1 fuel delivery will occur every 10 days and 1 water truck delivery every three days.

There will be no dominant traffic flow direction for the program, with traffic likely to be roughly split between traffic from Alice Springs and each program.

Movement of heavy loads (i.e. drilling rig mobilisation and demobilisations) through regional centres will be avoided.

During crew change over, a bus service will be available to transport the crews (whether they drive in/out or fly in/out) from Alice Springs to site. In addition, CP is evaluating the use of the Mereenie air strip to move staff and sub-contractors for the wells west of Alice Springs.

Dingo Field

Dingo 1 and Dingo 5 are located within the Dingo Gas Field, northeast of the Amadeus Basin, approximately 60 km south of Alice Springs. The Dingo Gas Field is accessed from Alice Springs via the unsealed Maryvale Road South for 46 km until the Santa Teresa turn off to the railway access track which turns left off the Maryvale Road and then goes directly to the edge of the Dingo Field at which point the wells are accessed via CP access tracks.

The Maryvale Road is a 105-kilometre road connecting Maryvale (Titjikala) Station to Alice Springs. Maryvale is a single carriage road with sealed and unsealed sections of road. The Department of Infrastructure, Planning and Logistics (DIPL) announced on August 4th 2020 that upgrades to 10 km of the Maryvale road will be undertaken to improve the transport network, the DIPL website states that the network upgrades will "increase connectivity and reduce travel times, in addition to cutting costs for freight operators and enhancing economic opportunities for the mining, cattle and tourism industries.

Existing traffic count figures were obtained from the DIPL Annual Traffic Report 2019 showing the Average Annual Daily Traffic (AADT) figures for the Maryvale Road, 16 km south of Santa Teresa Road.

The total daily traffic flows from the 2018 AADT are in the order of 156 vehicles, effectively split between inbound and outbound (refer Figure 4-10).

Rural Coverage Count Stations

Table: 4.1 AADT For Coverage Stations - 10 Year Period

Year: 2019

Region: Alice Springs

Road Name / Location	ADT Station	Direction	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Larapinta Drive 5km West of Areyonga Road	RAVDC077	Inbound	Veh	18		24		25		25		27	
		Outbound	Veh	18		21		23		25		27	
		Both	Veh	36		45		48		50		54	
Luritja Road 16km North of Lasseter Highway	RAVDC061	Inbound	Veh	113		87		98		104		122	
		Outbound	Veh	118		92		111		98		102	
		Both	Veh	231		179		209		202		224	
Maryvale Road 16km South of Santa Teresa Road	RAVDC051	Inbound	Veh	32		49		52	63	77		80	
		Outbound	Veh	30		49		54	64	77		76	
		Both	Veh	62		98		106	127	154		156	
Mulga Park Road 16km West of Stuart Highway	RAVDC065	Inbound	Veh	10		11		8		9		12	
		Outbound	Veh	9		13		8		12		11	
		Both	Veh	19		24		16		21		23	

Figure 4-10 Traffic flows on the Maryvale Road

Orange Exploration Permit EP82

Orange 3 Well is located in the northeast of the Amadeus Basin, approximately 40 km south of Alice Springs. The Orange-3 Well is accessed from Alice Springs via the Stuart Highway to an existing access track at which point the wells are accessed via CP access tracks.

Rural Coverage Count Stations

Table: 4.1 AADT For Coverage Stations - 10 Year Period

Year: 2019

Region: Alice Springs

Road Name / Location	ADT Station	Direction	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Stuart Highway 1km South of Airport Intersection	RAVDC073	Inbound	Veh	806	766	769	688	806	734	826	818	1016	771
		Outbound	Veh	816	762	757	700	765	834	817	815	1214	835
		Both	Veh	1622	1528	1526	1388	1571	1568	1643	1633	2230	1606

Figure 4-11 Traffic flows on the Stuart Highway

The total daily traffic flows from the 2019 annual survey data are in the order of 1606 vehicles; effectively split evenly between inbound and outbound (refer Figure 4-11). The total anticipated peak traffic volume for the project has been determined at 1626 vehicles per day. This consists of an additional peak project vehicle movement level of 20 vehicles/day in addition to the existing 1606 vehicles/day. The total volume of traffic is considerably lower than the capacity of the Stuart Highway, with any reduction in level of service (LOS) from the volume of project traffic considered extremely unlikely.

Palm Valley Field

Palm Valley 12 is located in the Palm Valley Gas Field, which is situated in the Amadeus Basin, approximately 154 km west of Alice Springs. Access to the field from Alice Springs is via a network of sealed and unsealed public and private roads, heading west from Alice Springs along Larapinta Drive/Red Centre Way to Hermannsburg, then turn left 6.5 km past the Finke River crossing near Hermannsburg. From this point the wells are accessed via CP access tracks.

Surprise Field

Mamlambo 1 is located in the Amadeus Basin, approximately 390 km west of Alice Springs. Access to Mamlambo-1 from Alice Springs is via the tourist turnoff onto Albert Namatjira Drive from Larapinta Drive, following the Haast Bluff/Kintore Road heading towards Pupunya. Continue through Papunya township onto Kintore Road for 197 kms and then onto Johnstone Access Road for 51 km.

Mereenie Field

Mereenie West 27 and 28 wells are located in existing Mereenie Field within the Amadeus Basin, approximately 280 km west of Alice Springs. Access to the field from Alice Springs is via a network of sealed and unsealed public and private roads, heading west from Alice Springs along Larapinta Drive/Red Centre Way to Hermannsburg, and then continuing towards Kings Canyon. The turn off to the Mereenie is left off the Red Centre Way; approximately 175 km past Hermannsburg. At which point the wells are accessed via CP's access tracks.

Larapinta Drive is the main highway to access to the Palm Valley, Mereenie and Surprise Fields. Larapinta Drive is a sealed single carriage road from Alice Springs to Hermannsburg, the road is unsealed west of Hermannsburg. The speed limit on the Larapinta Drive is 110 km/h unless otherwise sign posted. Larapinta drive is utilised by the local community, as well as, providing access to a number of tourist attractions.

Existing traffic figures were obtained from the DIPL Annual Traffic Report 2018 for the Larapinta Drive 1km east of Larapinta / Namatjira intersection. This location can be assumed that the traffic figures at the Mereenie, Palm Valley and site will be similar. The peak dry season traffic volume is 731 vehicles with the AADT 447 vehicles (refer Figure 4-12).

Rural Primary Count Stations

Table: 2.2 Calculated AADT and Monthly ADT for Primary Stations

Key: Adjusted Data

Year: 2019

Region: Alice Springs

Road Name / Location	Station No	Direction	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AADT
Larapinta Drive	RAVDP002	Inbound	Veh	131	142	151	258	256	307	375	296	284	224	164	138	228
1km East of Larapinta/Namatjira Intersection		Outbound	Veh	131	139	147	244	246	289	356	285	269	216	162	133	219
		Both	Veh	262	281	298	502	502	596	731	581	553	440	326	271	447
Larapinta Drive	RAVDP013	Inbound	Veh	11	11	14	43	36	52	76	49	51	32	14	10	33
30km North of Kings Canyon (at jump up)		Outbound	Veh	14	15	16	34	28	35	48	38	33	27	16	11	26
		Both	Veh	25	26	30	77	64	87	124	87	84	59	30	21	59
Lasseter Highway	RAVDP007	Inbound	Veh	92	89	104	205	193	231	333	240	247	223	530	87	214
500m West of Stuart Highway		Outbound	Veh	104	104	128	251	220	307	382	272	296	222	541	98	244
		Both	Veh	196	193	232	456	413	538	715	512	543	445	1071	185	458
Lasseter Highway	RAVDP008	Inbound	Veh	147	132	158	319	296	379	547	376	390	327	158	120	280
500m East of Yulara/Airport Intersection		Outbound	Veh	133	128	154	318	282	382	533	366	392	305	153	120	273
		Both	Veh	280	260	312	637	578	761	1080	742	782	632	311	240	553

Figure 4-12 Traffic flows on Larapinta Drive

The anticipated peak project vehicle movement level is <20 vehicles/day in addition to the existing peak dry season traffic volumes.

The total volume of traffic is considered lower than the capacity of the Stuart Highway, Larapinta Drive and Maryvale Road, with any reduction in LOS from the volume of project traffic considered unlikely.

Once the Drilling Contractor is confirmed and prior to the project commencing, a Traffic Management Plan will be prepared, and approval gained from DIPL.

5.0 Description of Environment

A description of the physical, natural and socio-economic environment for each of the wells is provided in the following sections. CP has completed baseline assessments for each of the proposed wells and used a combination of desktop and baseline results to develop an accurate description of the current environment.

If CP becomes aware of any additional information not contained in the EMP in relation to the existing environment that may influence the results of the risk assessment and mitigation measures outlined in this EMP, it will undertake a review of the EMP.

5.1 Dingo Wells

5.1.1 Physical Environment

5.1.1.1 Climate

The proposed Dingo well sites experience an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable.

Climate data has been summarised using all available data from the nearest Bureau of Meteorology weather station to the wells (015590, Alice Springs) and Table 5-1 shows the mean maximum and minimum temperature, mean rainfall, highest rainfall, lowest rainfall, mean days of rain and mean evaporation for each month.

Table 5-1 Climate Data (Dingo Wells)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	36.5	35.2	32.8	28.4	23.2	19.9	19.9	22.7	27.4	31.2	33.8	35.5
Mean minimum temperature (°C)	21.6	20.8	17.6	12.6	8.2	5.0	4.0	5.9	10.3	14.8	17.9	20.3
Mean rainfall (mm)	40.6	41.2	31.0	16.5	18.5	13.0	14.9	8.6	8.7	20.0	28.2	38.1
Highest rainfall (mm)	99.6	111.8	204.8	85.6	56.6	70.6	76.8	63.0	29.0	38.8	53.2	135.8
Lowest rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean days of rain	4.8	4.5	3.2	2.1	2.9	2.7	2.5	1.8	2.3	4.4	5.4	5.9
Mean evaporation (mm)	399.9	333.2	322.4	231.0	151.9	111.0	127.1	176.7	246.0	319.3	351.0	378.2

5.1.1.2 Geology

The proposed Dingo wells are located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km² and a maximum sediment thickness of 14 000m with several major depocentres including the Idirriki, Carmichael and Ooraminna Sub-basins and Missionary Plain Trough along the northern margin and the Mount Currie and Seymour Sub-basins in the south (Geoscience Australia, 2020). It is bound in the north by the Arunta complex and in the

south by the Musgrave Mann complex, both containing granite, gneiss and schists, with amphibolite and quartzite.

The general stratigraphy of the region is shown in Figure 5-1

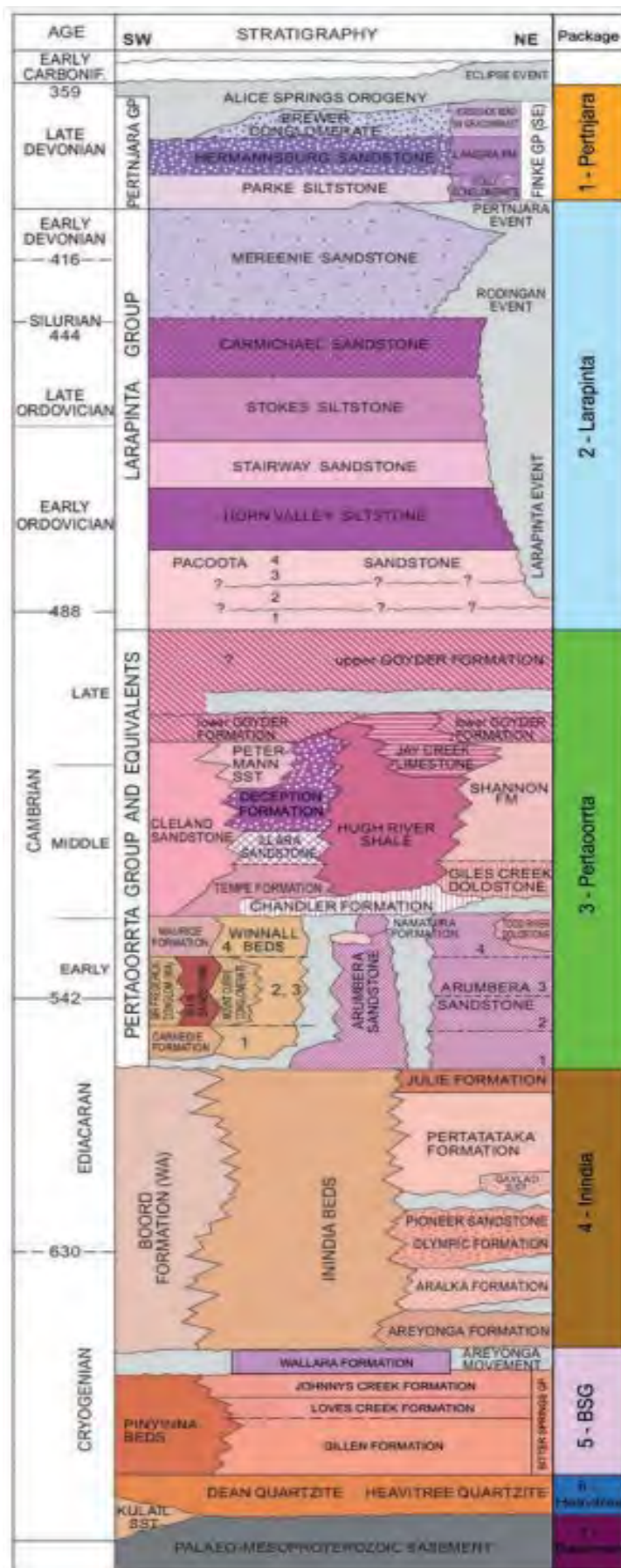


Figure 5-1 Amadeus Basin Stratigraphy (Schmid et al., 2016)

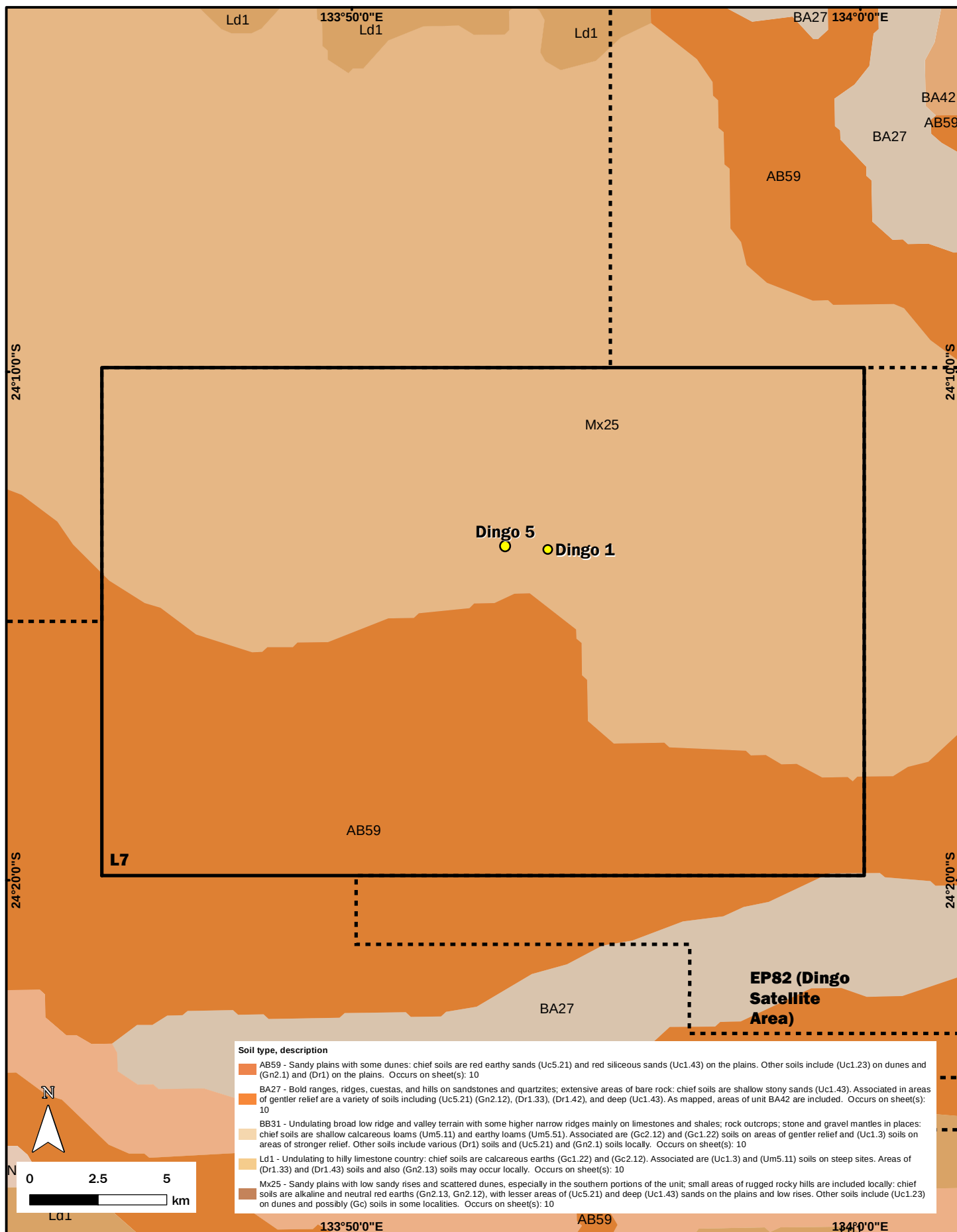
5.1.1.3 Regional Soils

Three soil types, as mapped using data from the Digital Atlas of Australian Soils (based on Northcote, et al., 1960-1968) are present within the wider Dingo gas field. Table 5-2 provides a description of these soil types with Figure 5-2 showing the location of the Dingo wells relative to the soil types.

The Dingo wells are located within the Mx25 soil type.

Table 5-2 Description of soils units (Dingo Wells)

Soil Type	Landform	Soils
Mx25	Sandy plains with low sandy rises and scattered dunes. Small areas of rugged rocky hills are included locally	Alkaline and neutral red earths, with lesser areas of deep sands
AB59	Sandy plains with some dunes	Chief soils are red earthy sands and red siliceous sands on the plains
BA27	Bold ranges, ridges, cuestas, and hills on sandstones and quartzites. Extensive areas of bare rock	Chief soils are shallow stony sands



ID: 0523-06
 Rev:
 Date: 1/06/2020
 Map Scale is 1:182,910 when printed at A4
 Coordinate System: GCS GDA 1994
 Digital Atlas of Australian Soils - 1991

Figure 5-2: Soil Units (Dingo Wells)

- Indicative well location
- Permit
- Permit farmout area



5.1.1.4 Land Systems

A land system is an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1968). Land system descriptions provide a general and consistent basis for determining potential habitat types present within the region of the survey areas. Land system mapping available for the Dingo wells is at a scale of 1:1,000,000 (Perry et al. 1962).

The Dingo wells are located within the Simpson land system as shown in Figure 5-3 and described in Table 5-3 .

Table 5-3 Land System (Dingo Wells)

Land System	Landform Class	Description
Simpson	Desert dunefields	Spinifex-covered sand dunes. Dunefields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.

5.1.1.5 Land Types

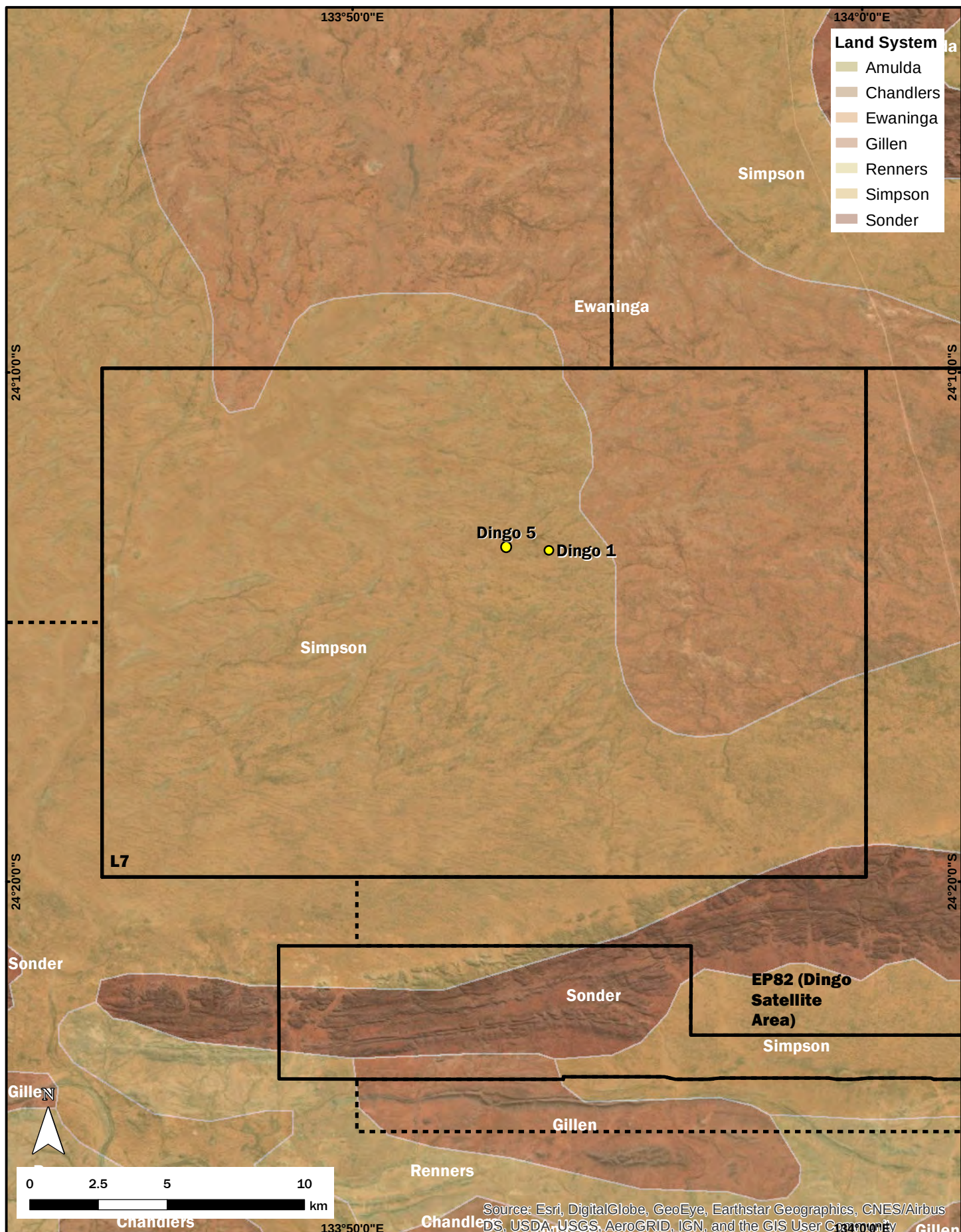
Land types build upon the land systems described in Section 5.1.1.4 and are a mapping unit that delineate areas of similar landform, soils and vegetation to a reasonable level of detail and accuracy. Land types within the Dingo well locations have been mapped at a scale of 1:5000 and are based on surveys conducted during February 2020.

Six land types were identified within the Dingo wells as described in Table 5-4 and shown in Figure 5-4.

Table 5-4 Land Types (Dingo Wells)

Land type	Description	Representative photograph
DG-A	Flat to gently undulating sandplain. Sandy soils, likely shallow sub-surface red earths, particularly in areas of higher Mulga densities. Low open woodland to open shrubland of <i>Acacia aneura</i> +/- <i>Acacia kempeana</i> , <i>Acacia estrophiolata</i> and <i>Senna artemisioides subsp. filifolia</i> over spinifex (<i>Triodia basedowii</i>).	
DG-B	Sandy rises and dune flanks. Sandy surface soils; unknown sub-surface. Open stands of Desert Oak (<i>Allocasuarina decaisneana</i>) with a sparse low shrubland of <i>Senna artemisioides subsp. filifolia</i> +/- <i>Acacia ligulata</i> over a sparse or patchy cover of spinifex (<i>Triodia basedowii</i>) and <i>Eragrostis eriopoda</i> .	

Land type	Description	Representative photograph
DG-C	Flat red earth plain. Sandy clay soils; typically occurs at low-points. Open tall shrubland of <i>Acacia aneura</i> (occasionally groved over sparse tussock grasses and occasional patch of spinifex and areas of sandier soils. Occasional <i>Acacia estrophiolata</i>.	
DG-D	Low sand dunes / sand hills. Red siliceous sands. Open to scattered Acacia shrubland (<i>Acacia ligulata</i>, <i>Acacia aneura</i>, <i>Acacia kempeana</i>, <i>Acacia estrophiolata</i>) over open spinifex grassland (<i>Triodia basedowii</i>). Occasional emergent <i>Allocasuarina decaisneana</i> mainly on dune flanks.	
DG-E	Gently sloping red earth sandplain. Sandy loam / sandy red earths. Open shrubland of <i>Senna artemisioides</i> subsp. <i>filifolia</i> +/- <i>Acacia ligulata</i> and sparse <i>Eragrostis eriopoda</i> and patchy spinifex (<i>Triodia basedowii</i>). Note cattle track in photograph.	
DG-F	Minor ephemeral drainage (weakly defined channel <1m width); sandy loam soils. Shrubland of Mulga (<i>Acacia aneura</i>) over sparse tussock grasses (unknown species due to dry conditions).	



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Rev:

Date: 1/06/2020

Map Scale is 1:182,910 when printed at A4
Coordinate System: GCS GDA 1994

Land Systems - Department of Environment and
Natural Resources

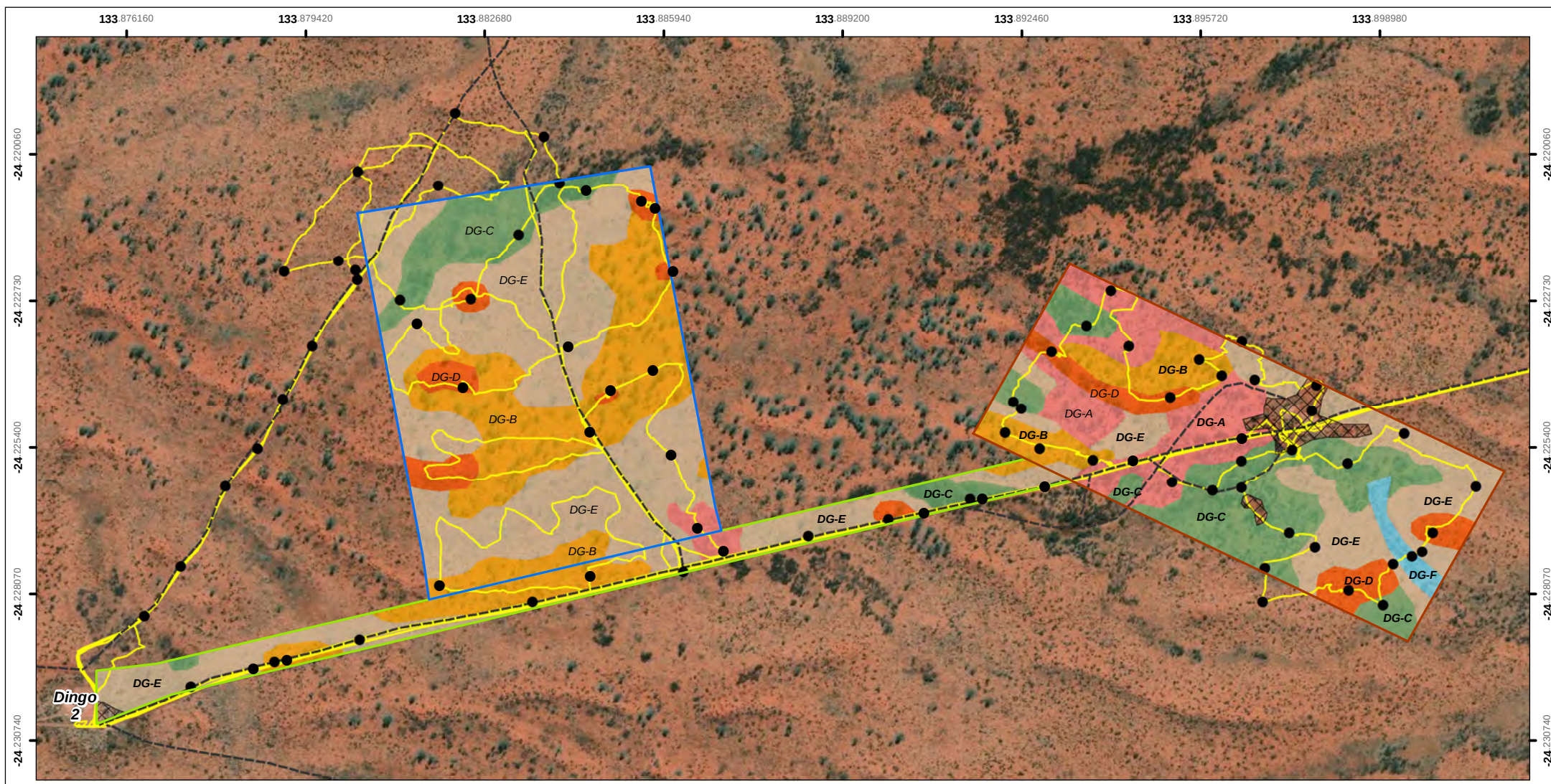
Figure 5-3: Land Systems (Dingo Wells)

- Indicative well location
- Permit
- Permit farmout area



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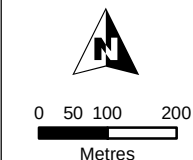




- Dingo 1 survey area
- Dingo 5 survey area
- Dingo 1 and 5 access corridor
- Check sites
- Survey transects
- Disturbed (previously cleared)
- Existing tracks or seismic lines

Land types (1:5,000) (ground-truthed)

- DG-A: flat to gently undulating sandplain with low open woodland to open shrubland of *Acacia aneura* +/- *Acacia kempeana*, *Acacia estrophiolata* and *Senna artemisioides* subsp. *filifolia* over spinifex (*Triodia basedowii*)
- DG-B: sandy rises and dune flanks with open stands of Desert Oak (*Allocasuarina decasneana*) with a sparse low shrubland of *Senna artemisioides* subsp. *filifolia* +/- *Acacia ligulata* over spinifex (*Triodia basedowii*) and native tussock grasses.
- DG-C: flat red earth plain with an open tall shrubland of *Acacia aneura* and possibly *Acacia aptaneura* (occasionally groved) over native tussock grasses (or spinifex in areas of sandier soils)
- DG-D: low sand dunes and sand hills with a sparse shrubland of *Acacia ligulata*, *Grevillea juncifolia*, *Acacia murrayana* and *Senna artemisioides* subsp. *filifolia* over spinifex (*Triodia basedowii*). Occasional patches of stunted *Acacia estrophiolata*.
- DG-E: gently sloping red earth sandplain with an open to sparse shrubland of *Acacia ligulata*, *Acacia murrayana* and *Senna artemisioides* subsp. *filifolia* over spinifex (*Triodia basedowii*) and native tussock grasses (*Eragrostis eriopoda*, *Aristida holathera*)
- DG-F: minor drainage (poorly defined channel) lined with *Mulga* (*Acacia aneura*) over native tussock grasses



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DINGO 1 & DINGO 5



MAP INFORMATION
 Scale: 1:11,000 @ A4
 Projection: GCS GDA 1994
 Date Saved: 8/05/2020
 Client: Enviro-Value
 Author / Mapper: TR

DATA SOURCE
 Survey area: Client
 Survey data: EcOz 2020
 Imagery: Maxar (3/7/2017)

Figure 5-4. - Land types present within the Dingo 1 and Dingo 5 clearance areas

5.1.1.6 Groundwater

The Dingo wells are located in the Amadeus Basin, an elongated east-west aligned sedimentary basin that covers an area of approximately 170 000 km² in central Australia. Lloyd and Jacobson (1987) define two main hydrogeological domains within the Amadeus Basin: the north-central area which has broad folding associated with extensive and mappable sandstone formations, elsewhere in the basin greater deformation has resulted in the development of a regional fractured rock groundwater systems. The Dingo wells are located in the north-east of the Amadeus Basin's north-central region and overlie a series of regional scale potential groundwater supply sources.

Existing production from the Dingo-2 well sources gas from a reservoir in the Arumbera Sandstone. The Dingo wells will target both the Arumbera Sandstone reservoir and deeper gas resources in the Pioneer Sandstone. Groundwater supply targets overlying the Arumbera Sandstone typically occur at significant depth (>500 m) and become shallower to the south of the Dingo wells (15-20 km) where they outcrop along the James Range.

Table 5-5 provides a summary of the stratigraphy and recorded groundwater occurrence beneath the Dingo wells from the surface to the Pioneer Sandstone.

Table 5-5 Local Stratigraphy and Groundwater Occurrence (Dingo Wells)

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Quaternary/Tertiary aged sediments	Surficial	20	Quartz sand, clay/ limestone, calcareous siltstone	Limited, potential for local useable supplies available when sufficient saturated thickness exists	Fresh to brackish	Yes
Pertnjara Formation	20	615	Sandstone, minor shale and siltstone	Poor	Brackish	No
Mereenie Sandstone	635	355	Quartz sandstone	Good potential for useable groundwater supplies across the region	Fresh	Yes
Horn Valley Siltstone	990	35	Shale, siltstone, dolomite	Poor	Not known	No
Pacoota Sandstone	1,025	360	Sandstone with siltstone and shale	Good potential for useable groundwater supplies across the region	Fresh	Yes
Goyder Formation	1,370	120	Shale, siltstone and dolomite	Good potential for useable groundwater supplies across the region	Fresh	Yes
Shannon Formation	1,490	370	Dolomite, shale		Brackish	Yes

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality [^]	Considered an aquifer for well design purposes
Hugh River Shale	1,860	240	Siltstone, shale, limestone, dolomite	Good potential for useable groundwater supplies across the region (Cambrian Carbonate Aquifer, after Short, 2018)	Brackish	No
Giles Creek Dolomite	2,100	305	Dolomite, siltstone, shale		Not known	No
Chandler Formation	2,405	275	Silty halite, minor limestone, mudstone	Poor Presence of evaporites suggests poor water quality	Saline	No
Todd River Equivalent	2,680	25	Mudstone	Poor (based on thickness and lithology)	Not known	No
Arumbera Sandstone	2,705	295	Interbedded sandstone, siltstone, shale	Gas Reservoir	Not known	No
Julie Formation	3,000	45	Sandstone and Shale	Poor	Not known	No
Pertatataka Formation	3,045	430	Siltstone and shale	Poor	Not known	No
Pioneer Sandstone	3,475	-	Pebbly, feldspathic sandstone	Gas Reservoir	Not known	No

*Depths and thickness based on Dingo-1 well

[^] Water quality assessment is made for formations under the Dingo field based on bore data or formation water quality from Dingo well completion reports with the exception of the Chandler Formation, which is based on anecdotal evidence in the Daily Drilling Reports of the Dingo well completion reports

The surface geology comprises Quaternary and Tertiary aged sands, clay and limestone. In areas where valleys or depressions have been incised into the underlying Pertnara Formation the Quaternary/Tertiary has sufficient saturated thickness to provide for localised groundwater supplies (e.g. RN002943 located 15 km to the west of Dingo-1 well). However, these groundwater sources are typically discontinuous and rare with water bore records⁴ suggesting attempts to target them have resulted in over 20 unsuccessful bores across the Orange Creek plains.

Water quality at RN002943 is poor potable quality⁵ (most recent Total Dissolved Solids (TDS) of 1,140 mg/L) but is typically variable in these local systems. This bore has been sampled seven times between 1962 and 1995, with a TDS range of 1,140 – 3,590 mg/L (EC⁶ range of 1,910 – 5,500 µS/cm), the mean across the data set is 3,060 mg/L TDS or 4,580 µS/cm EC. The population is skewed by the most recent sample collected in 1995 (1,140 mg/L TDS, 1910 µS/cm) which was unusually fresh relative to the rest of the data set. The bore was sampled by Water Resources and therefore is considered a reliable

⁴ See drilling records for RN002943 - <http://www.ntlis.nt.gov.au/hpa-services/borereport?bore=RN002943>

⁵ The Australian Drinking Water Guidelines (ADWG, 2011) do not identify health guideline value for total dissolved solids (TDS), as there are no health effects directly attributable to TDS. However, for good palatability total dissolved solids in drinking water should not exceed 600 mg/L. The ADWG identify TDS in excess of 1,200mg/L as unacceptable as it is unpalatable.

⁶ Total dissolved solids in mg/L can be estimated from electrical conduction in µS/cm by multiplying the electrical conductivity by 0.65.

result. It is possible that the low salinity of this sample relates to either the bore not being adequately purged prior to sampling or possibly reflects a freshening of groundwater after a recharge event.

The underlying Pertnjara Formation has poor groundwater potential – the formation is not differentiated around the Dingo field, though regionally it is separated into the Brewer Conglomerate and the basal Hermannsburg Sandstone. Water bore records suggest that most groundwater bores drilled through the alluvial sequence penetrate into the Brewer Conglomerate and intersect limited groundwater flows of brackish water quality (average TDS of 9,400 mg/L). Bore RN010368 was drilled to 640 m through the Pertnjara Formation with a final yield of 0.2 L/s. During drilling of the Dingo gas wells potable groundwater was intersected in the base of the Pertnjara Formation – the flow was estimated at between 50 and 100 Bbl/hour (2.2 – 4.4 L/s) with a potable water quality of 550 μ S/cm EC. It is possible that this groundwater intersection occurs from the Hermannsburg Sandstone, which although not distinguished in the geological logs, forms an important groundwater source in other parts of the Amadeus Basin.

The Meerenie Sandstone underlies the Pertnjara Formations at depths in excess of 600 m. The Meerenie Sandstone is one of a series of regionally extensive formations that are used for groundwater supplies in the central north of the Amadeus Basin. It is of particular significance in the north of the basin where it provides the water supply for Alice Springs. In the vicinity of the Dingo wells the groundwater flow direction in the Meerenie Sandstone is from the north and west toward the east (Tickell, 2008, Macqueen and Knott, 1982). A groundwater divide is mapped roughly 26km to the north of the Dingo wells by Tickell (2008), separating the gas fields from the Roe Creek borefield which supplies Alice Springs. More recent mapping by Cook et al. (2020) indicates that the divide has likely shifted southwards due to continued drawdown at Roe Creek, however it is unclear whether the Dingo well sites would be north or south of this divide. Bore yields of up to 100 L/s have been recorded in the Meerenie Sandstone at Roe Creek, though this is attributed to very high secondary permeability (Macqueen and Knott, 1982) and is not representative of the formation regionally.

No bores have been constructed in the formation beneath the Dingo wells, however, a flow rate of 300 Bbl/hour (13 L/s) was estimated during the drilling of Dingo well 4 with a potable water quality of 520 μ S /cm EC. Transmissivities of up to 4,000 m²/day have been observed though 600 m²/day is considered representative for the formation at a regional scale (Macqueen and Knott, 1982).

The Pacoota Sandstone underlies the Meerenie Sandstone and extends from the northern margin of the basin near Alice Springs to the High River south of the Dingo wells. Bore yields in the Pacoota Sandstone range from 0.1 – 80 L/s with a mean 11.4 L/s from 49 bores (Lau and Jacobson, 1991). Transmissivities range from 20 – 1,300 m²/day with a regional estimate of 600 m²/day (Macqueen and Knott, 1982). No bores are constructed in the Pacoota Sandstone within 10 km of the Dingo field, however, a formation water sample with a TDS of 500 mg/L (EC of 770 μ S/cm) collected during the drilling of Dingo-4 well suggests the groundwater quality is potable beneath the lease. The groundwater flow direction in the Pacoota Sandstone across the Dingo wells is from the north-west to the south-east/east (Lau and Jacobson, 1991).

Regionally, the Goyder Formation, Shannon Formation, Hugh River Shale and Giles Creek Formation all contain noteworthy groundwater resources though the formations occur at significant depth in the vicinity of the Dingo wells (>1,400 m). To the southeast of the Dingo wells around Orange Creek these formations have loosely been grouped together as the Cambrian Carbonate Aquifer (CCA) (Short, 2018). In this area the CCA has a licensed allocation of 1,170 ML/year which supports agriculture and industry. Bore yields range from 0.1 – 31 L/s with transmissivities from 4 – 580 m²/day (Jacobson and Lau, 1991). There are no bores constructed in the CCA formations in the immediate area around the Dingo wells. Grab samples of formation water taken during drilling of the existing Dingo gas wells indicates potable water occurs in the Goyder Formation (EC of 960 μ S/cm) but groundwater is saline

within the deeper Shannon Formation and Giles Creek Formation (42,800 $\mu\text{S}/\text{cm}$ and 47,800 $\mu\text{S}/\text{cm}$ respectively).

Limited information is available on flow directions within these formations but a combined potentiometric of the Pacoota/Goyder Formations suggests the groundwater flow direction is consistent with the overlying formations and flows toward the east/south-east (Macqueen and Knott, 1982).

5.1.1.6.1 Groundwater Bores

A search of the groundwater bores on NR Maps⁷ identified six registered bores within a 10 km radius of the Dingo wells, key details for each bore are summarised in Table 5-6. Two records are associated with gas exploration wells (RN014732 - Dingo-1 well and RN014733 - Dingo 2 well). The remaining four bores were drilled through unsaturated Quaternary and Tertiary sediments into the underlying Pertnjarra Formation (locally the Brewer Conglomerate) which does not contain notable groundwater resources. All four bores were either backfilled or constructed and abandoned at time of drilling.

Table 5-6 Summary of Registered Bores within 10 km (Dingo Wells)

Bore ID	Distance from Dingo-1 ST1 / 5 (km)	Formation	Drilled Depth (mBGL)	Groundwater		Status	Owned by CP
				EC ($\mu\text{S}/\text{cm}$)	Depth (mBGL)		
RN014732	0 / 1.1	-	3092.5	-	-	Dingo-1 well	Yes
RN014733	1.8 / 0.7	-	3085	-	-	Dingo 2 well	Yes
RN005413	2.1 / 0.4	Pertnjarra Formation	65.8	-	-	Not cased	No
RN007295	5.4 / 6.4	Pertnjarra Formation	24.1	13,200	21.6	Not located in 1986 audit	No
RN010368	4.5 / 5.5	Pertnjarra Formation	640	13,300	24.4	Surface casing only	No
RN010373	2.2 / 3.2	Pertnjarra Formation	106.7	-	-	Not cased	No

The bore locations, relative to the Dingo well leases are shown in Figure 5-6. Bores marked with a blue circle are recorded as “current” in NR Maps, while bores marked with a cross are designated as historical, and were either not constructed or have been abandoned. Note that two bores (RN005413 and RN010368) are registered as current, however, the bore records suggest they were not constructed or were abandoned with only surface casing. The nearest active groundwater bore is RN002943, which taps a shallow Tertiary groundwater resource approximately 15 km west of the existing Dingo-1 well. Several active bores also occur 15 - 20 km south of the Dingo wells along the James Range, the majority of these bores supply groundwater for stock watering on Orange Creek and Deep Well stations. Water supplies for the drilling campaign will be sourced from a commercial supplier, therefore there is no potential to impact on the supply potential of the surrounding groundwater bores.

⁷ <https://nrmaps.nt.gov.au/>

The closest groundwater monitoring bore is RN011854, which screens the Mereenie Sandstone approximately 25 km south-west of the Dingo wells. RN011854 was monitored from 1985 to 2004 (Figure 5-5), water levels gradually decline over this period at a rate of 0.08 m/year. There is a notable increase in groundwater levels between 2000 and 2001, this was a particularly wet period in central Australia and suggests that the Mereenie Sandstone is receiving some active recharge in this area.

5.1.1.6.2 Wetlands, Springs and Groundwater Dependant Ecosystems

Duguid (2013) undertook a comprehensive review of wetlands within the Alice Springs Water Control District and found that the majority of wetlands in the district are intermittent and only hold water after rainfall events. The report did not identify any groundwater fed wetlands or springs (groundwater dependent ecosystems) in the vicinity of the Dingo wells.

While there is the potential for terrestrial GDEs to be associated with shallow, Quaternary/Tertiary groundwater sources, water supplies for the Dingo wells will be sourced from commercial suppliers, therefore there is negligible potential for water level drawdown to affect these GDEs.

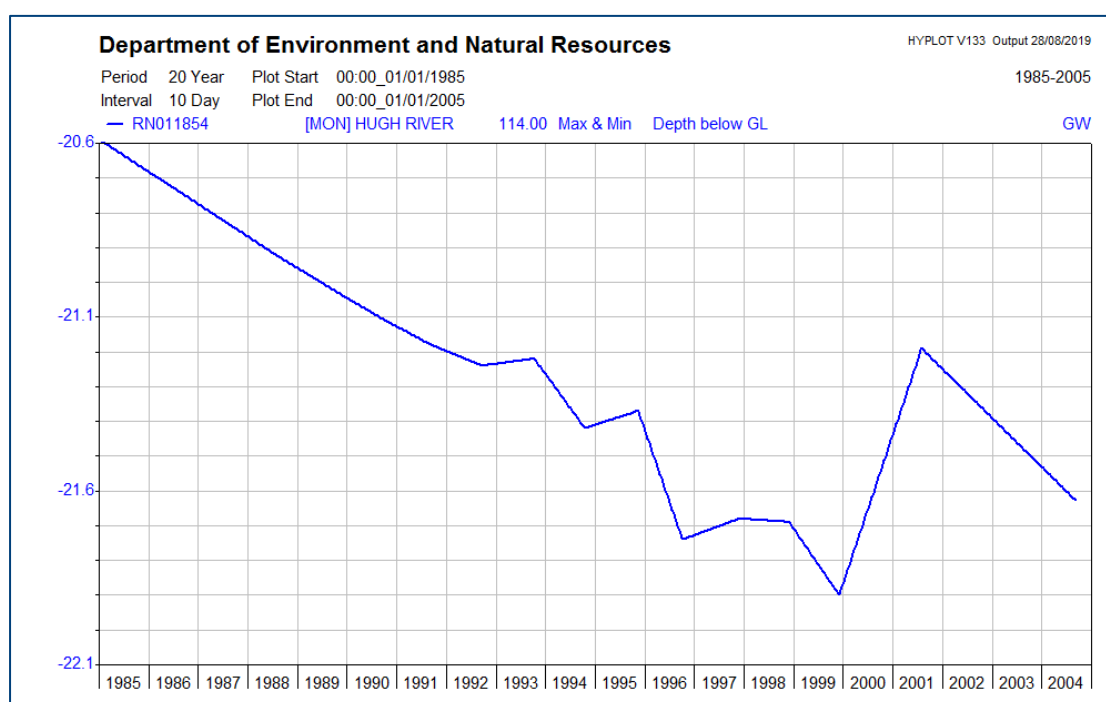


Figure 5-5 Hydrograph for RN011854

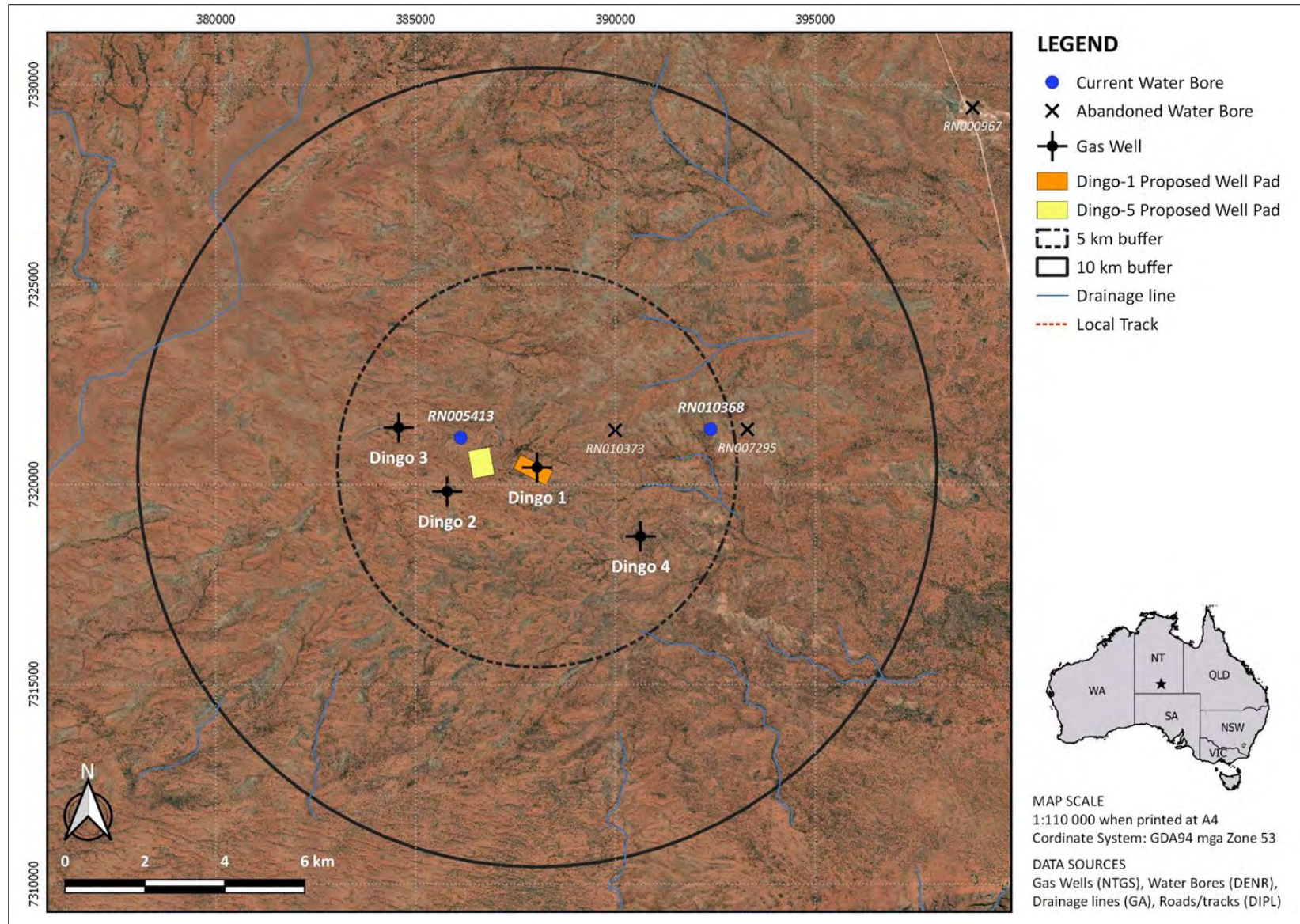


Figure 5-6 Groundwater bores within 10 km (Dingo Wells)

5.1.1.7 Surface Water

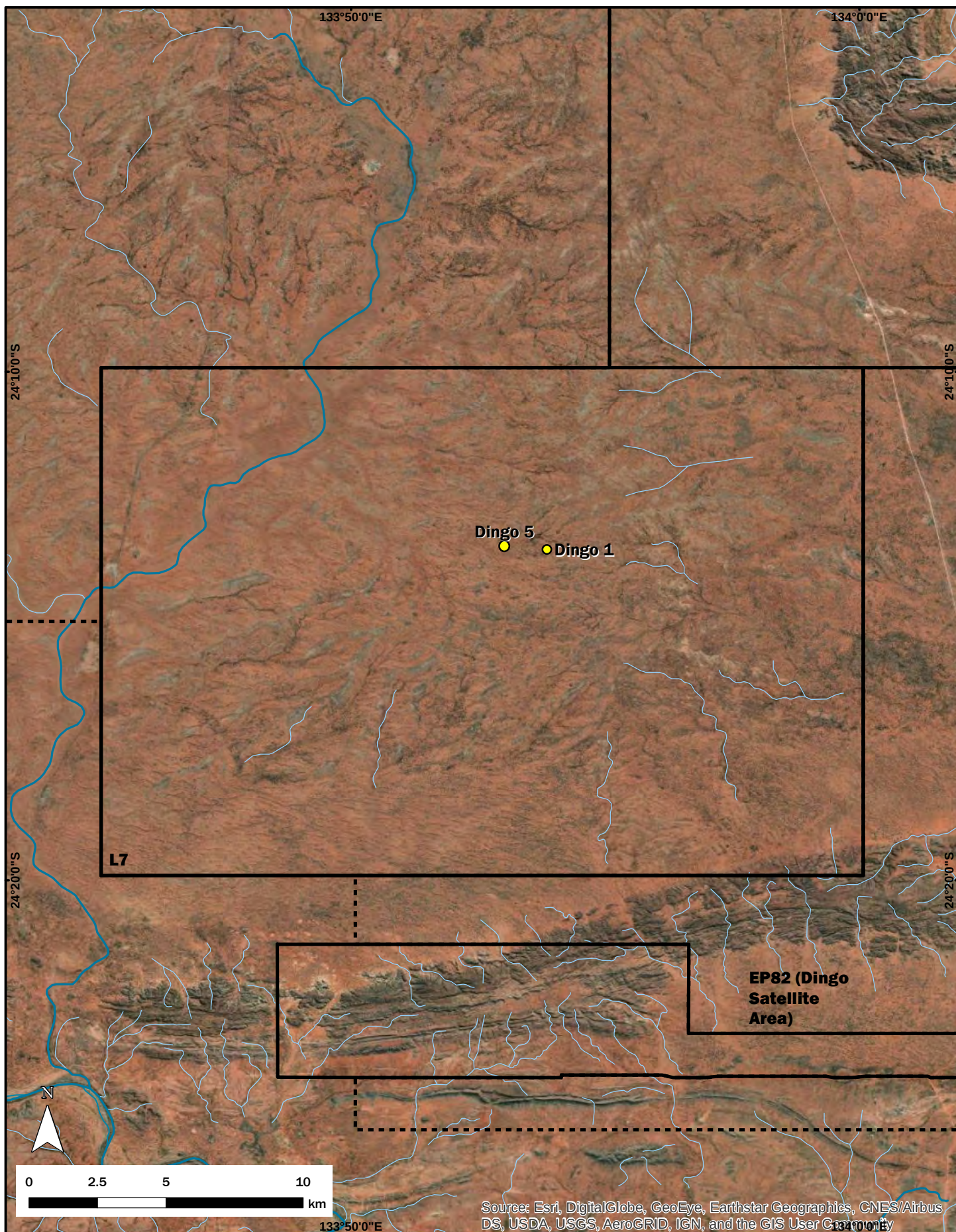
The Dingo gas field is situated within both the Finke River and Todd River Basins, both of which are within the Lake Eyre basin. The Lake Eyre basin covers almost one-sixth of Australia and is one of the world's largest internally draining river systems. The area supports a range of nationally important natural, social and economic values. All community sectors across the Lake Eyre Basin, scientists and governments, are involved in a collaborative effort (principally under the Lake Eyre Basin Intergovernmental Agreement) to ensure that the health of the unique river systems of the basin can be maintained (Australian Government, 2011).

The only major watercourse in the Dingo gas field area is an unnamed ephemeral tributary of the Hugh River located approximately 20 km to the west of the Dingo well sites (refer Figure 5-7).

Smaller drainage lines are mapped as being present approximately 10 km to the east of the Dingo wells. The buffer distance to stream orders from the disturbance areas is in line with the recommended widths specified in the DEPWS Land Clearing Guidelines (2019).

Flood modelling of the proposed Dingo-5 well lease has been undertaken and the well lease is not located within the 1% ⁸ AEP rainfall event (refer Appendix 1).

⁸ 1% AEP is equivalent to a 1:100 rainfall event



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Northern Territory Mapped Streams - Department
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Figure 5-7: Surface hydrology (Dingo Wells)

- Indicative well location
- Minor Drainage
- Permit
- Permit farmout area
- Streams
- Major Drainage



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5.1.2 Natural Environment

5.1.2.1 Bioregions

The Dingo wells are located within the Finke bioregion (refer Figure 5-8) as classified by (Baker, et al., 2005) and described in Table 5-7 .

Table 5-7 Bioregions (Dingo Wells)

Bioregion	Topography	Geology	Soils	Vegetation
Finke	Geomorphologically variable complex of low sandstone ranges, weathered tablelands and rounded metamorphic hills, giving rise to undulating plains and low hills with extensive sand plains and sand dunes and flood outs	Lies over the Amadeus Basin and small parts of the Pedirka and Eromanga Basins. Contains sedimentary rocks of Devonian and Cambrian age	Soils are a mix of shallow and deep sands, massive earths, and red duplex saline affected soils.	Dominant vegetation includes hummock grasslands, <i>Acacia</i> shrublands and Saltbush / Bluebush open shrublands

5.1.2.2 Sites of Conservation Significance

There are currently 67 Sites of Conservation Significance (SOCS) identified by the Northern Territory government. (SOCS) are areas defined by the Northern Territory government as important sites for biodiversity conservation that need further protecting.

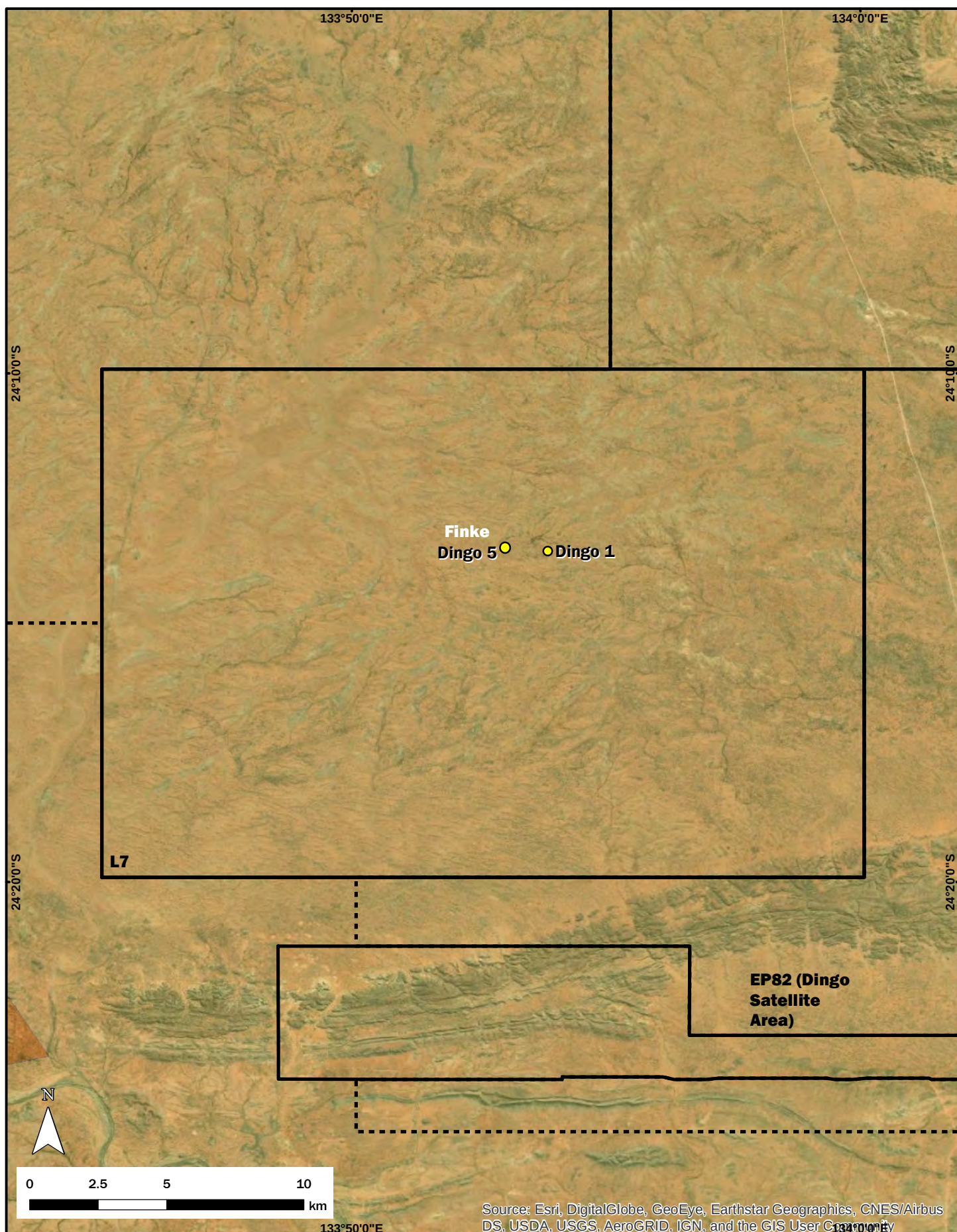
The closest SOCS to the Dingo wells is the Greater MacDonnell Ranges, located approximately 30 km to the south-west. Figure 5-9 provides an overview of the Dingo wells relative to the nearest SOCS.

5.1.2.3 Sites of Botanical Significance

A Site of Botanical Significance (SOBS) is an area that has been defined (by White et al. 2000) to hold important and / or unique botanical assemblages that require protection. SOBS are designated as either nationally significant (41 sites), bioregionally significant (79 sites) or of undetermined significance (33 sites).

Currently there is no specific legislation attached to SOBS, although protection of the SOBS is administered through other pieces of legislation (e.g. TPWC Act etc)

The Dingo wells are not located within a SOBS and therefore will not impact on the SOBS.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Interim Biogeographic Regionalisation for Australia
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Department of Sustainability, Environment, Water,
Population and Communities

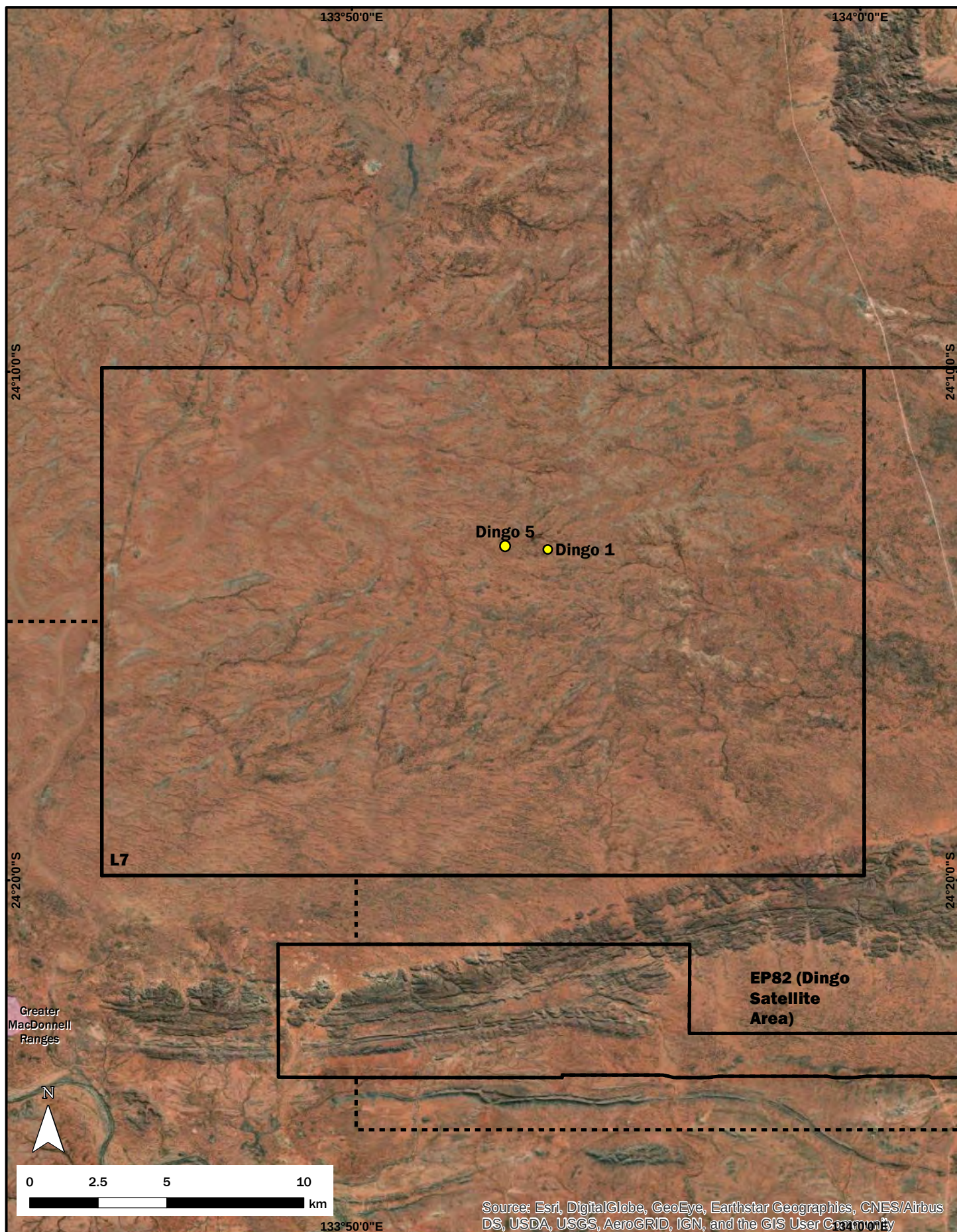
Figure 5-8: Bioregions (Dingo Wells)

- Indicative well location
- Permit
- IBRA region
- Permit farmout area
- Finke
- MacDonnell Ranges



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Sites of Conservation Significance from
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Figure 5-9: SOCS (Dingo Wells)

● Indicative well location

□ Permit

□ Permit farmout area

Sites of Conservation Significance

□ International



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5.1.2.4 Threatened Ecological Communities

No threatened ecological communities were identified within the proposed Dingo wells clearance area.

5.1.2.5 Conservation Significant Flora

A flora species is considered in this EMP to be of conservation significance if it is:

- Listed as Extinct in Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT) or Data Deficient (DD) under the TPWC Act and has been either:
 - recorded in the Northern Territory Flora Atlas within the sub-bioregion of the Dingo wells clearance area or
 - has been recorded during an ecological assessment of the Dingo wells clearance area or
- Listed as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Conservation Dependent (CD) under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Dingo wells clearance area or
 - has been recorded during field surveys of the Dingo wells clearance area.

Based on the results of desktop searches, baseline ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Dingo wells clearance area, Table 5-8 provides a summary of flora species of conservation significance which may be present within the Dingo wells clearance area and identifies the likelihood of each species occurring based on ground truthing within the Dingo wells clearance area.

Whilst no conservation significant flora was detected during the baseline ecological assessment in February 2020, twenty-nine flora species were recorded within the Dingo wells clearance area of which:

- One was an introduced species (*Cenchrus ciliaris*)
- Remaining species are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

Table 5-8 Conservation Significant Flora (Dingo Wells)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Ecological Survey Result	Likelihood of Occurrence ⁹
<i>Acacia latzii</i>	Tjilpi Wattle	VU	VU	-	4	No	Unlikely
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	VU	VU	May occur	0	No	Unlikely
<i>Eremophila prostrata</i>	Rainbow Valley Fuchsia Bush	NT	VU	Known to occur	18	No	Unlikely
<i>Macrozamia macdonnellii</i>	MacDonnell Ranges Cycad	NT	VU	Likely to occur	0	No	Unlikely
<i>Minuria tridens</i>	Minnie Daisy	VU	VU	Known to occur	0	No	Unlikely
<i>Santalum acuminatum</i>	Desert Quandong, Native Peach	VU	-	-	5	No	Unlikely

⁹ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

5.1.2.6 Conservation Significant Fauna

A fauna species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Fauna Atlas within the sub-bioregion of the Dingo wells clearance area or
 - has been recorded during an ecological assessment of the Dingo wells clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Dingo wells clearance area or
 - has been recorded during an ecological assessment of the Dingo wells clearance area.

Based on the results of desktop searches, previous ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Dingo wells clearance area, Table 5-9 provides a summary of fauna species of conservation significance which may be present within the Dingo wells clearance area and identifies the likelihood of each species occurring based on ground truthing within the Dingo wells clearance area.

Whilst no conservation significant fauna were detected during the baseline ecological assessment in February 2020, ten fauna species were recorded within the Dingo wells clearance area of which:

- Four bird, two reptile and four mammal species were detected
- All are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

In addition, Key habitat features within the survey area were identified - namely spinifex sandplains, sandy red earth plains, low sand dunes, dune swales / red earth depressions and a minor drainage. The survey in Appendix 2 indicates that the area is unlikely to support threatened species, including the Southern Marsupial Mole, Grey Falcon and Princess Parrot.

Table 5-9 Conservation Significant Fauna (Dingo Wells)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Ecological Survey Result	Likelihood of Occurrence ¹⁰
<i>Amytornis modesta</i>	Thick-billed Grasswren	EN	VU	May occur	0	No	Unlikely
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CR	Likely to occur	4	No	Unlikely
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU	VU	May occur	0	No	Unlikely
<i>Falco hypoleucos</i>	Grey Falcon	VU	-	-	22	No	Unlikely
<i>Limosa lapponica</i>	Bar-tailed Godwit	VU	-	-	6	No	Unlikely
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	May occur	0	No	Unlikely
<i>Polytelis alexandrae</i>	Princess Parrot	VU	VU	Known to occur	3	No	Unlikely

¹⁰ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Ecological Survey Result	Likelihood of Occurrence ¹⁰
<i>Rostratula australis</i>	Australian Painted-snipe	VU	EN	May occur	1	No	Unlikely
<i>Liopholis slateri</i>	Slater's Skink	VU	EN	May occur	78	No	Unlikely
<i>Isodon auratus</i>	Golden Bandicoot	EN	VU	-	3	No	Unlikely
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	-	2	No	Unlikely
<i>Notoryctes typhlops</i>	Southern Marsupial Mole	VU	-	-	6	No	Unlikely
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby	NT	VU	Known to occur	3	No	Unlikely
<i>Pseudomys australis</i>	Plains Mouse	EN	VU	-	1	No	Unlikely
<i>Rattus tunneyi</i>	Pale Field-rat	VU	-	-	1	No	Unlikely
<i>Trichosurus vulpecula</i>	Common Brushtail Possum (central)	EN	-	-	1	No	Unlikely
<i>Zyzomys pedunculatus</i>	Central Rock-rat	EN	CE	May occur	1	No	Unlikely
<i>Chlamydogobius japalpa</i>	Finke Goby	VU	-	-	5	No	Unlikely
<i>Semotrachia euzyga</i>	a land snail	EN	EN	-	1	No	Unlikely
<i>Sinumelon bednalli</i>	Bednall's Land Snail	NT	CR	May occur	6	No	Unlikely

5.1.2.7 Weeds

Weeds managed under this EMP can be categorised via the following methods:

- Weeds of National Significance (WoNS) – nationally agreed priority flora species for control and management. Weed species are determined based on rankings for invasiveness, potential to spread, and impact on socio-economic and environmental assets. There are currently 32 WoNS with each having an endorsed strategic plan which outlines tactics and actions for control
- Declared Weeds - species which have been identified for control, eradication, or prevention of entry in all or part of the Northern Territory under the *Weeds Management Act 2001*. Declared weeds can be of the following classes:
 - Class A – to be eradicated
 - Class B – growth and spread to be controlled
 - Class C – not to be introduced into the NT
- Priority / alert weeds – species which have been identified as a priority or alert weed species within the Alice Springs Regional Weed Management Plan 2013-2018.

Based on a 50 km radius from the Dingo wells, the eighteen weeds identified in Table 5-10 have been recorded locally.

Table 5-10 Weed Records (Dingo Wells)

Scientific Name	Common Name	WONS	Declared	Priority / Alert
<i>Andropogon gayanus</i>	Gamba grass	✓	✓	
<i>Argemone ochroleuca</i>	Mexican poppy		✓	
<i>Calotropis procera</i>	Rubber bush		✓	✓
<i>Carthamus lanatus</i>	Saffron thistle		✓	
<i>Cenchrus echinatus</i>	Mossman river grass		✓	
<i>Cenchrus setaceus</i>	Fountain grass		✓	
<i>Cylindropuntia fulgida</i>	Rope cactus - fulgida	✓	✓	✓
<i>Cylindropuntia imbricata</i>	Rope cactus - Devils rope	✓	✓	✓
<i>Echium plantagineum</i>	Patterson's curse		✓	
<i>Opuntia stricta</i>	Prickly pears - stricta	✓	✓	✓
<i>Parkinsonia aculeata</i>	Parkinsonia	✓	✓	✓
<i>Prosopis pallida</i>	Mesquite	✓	✓	
<i>Ricinus communis</i>	Castor oil plant		✓	
<i>Senna occidentalis</i>	Senna - Coffee		✓	
<i>Sida acuta</i>	Sida - Spiny head		✓	
<i>Tribulus terrestris</i>	Caltrop - terrestris		✓	
<i>Xanthium spinosum</i>	Burr - Bathurst		✓	
<i>Xanthium strumarium</i>	Burr - Noogoora		✓	

A baseline weed assessment was undertaken of the Dingo sites by a suitably qualified person in February 2020 and no WONS or declared weeds were observed. Buffel Grass (*Cenchrus ciliaris*), a significant threat weed under the Alice Springs Regional Weed Management Plan 2013-2018, was detected within the following locations:

- Dingo-1 ST1 – areas of existing disturbance associated with the Dingo-1 well site
- Dingo-5 – Land type D5-C.

5.1.2.8 Introduced Fauna (Pests)

An introduced fauna species is considered in this EMP to be of management concern if it is:

- Listed in the Northern Territory Fauna Atlas as “Introduced” and has been recorded within a 50 km buffer of the Mamlambo-1 clearance area or has been recorded on ecological surveys of the area; or
- Identified as an invasive species by an EPBC Protected Matters Search Tool report within a 50 km buffer of the Mamlambo-1 clearance area or has been recorded in ecological surveys of the area.

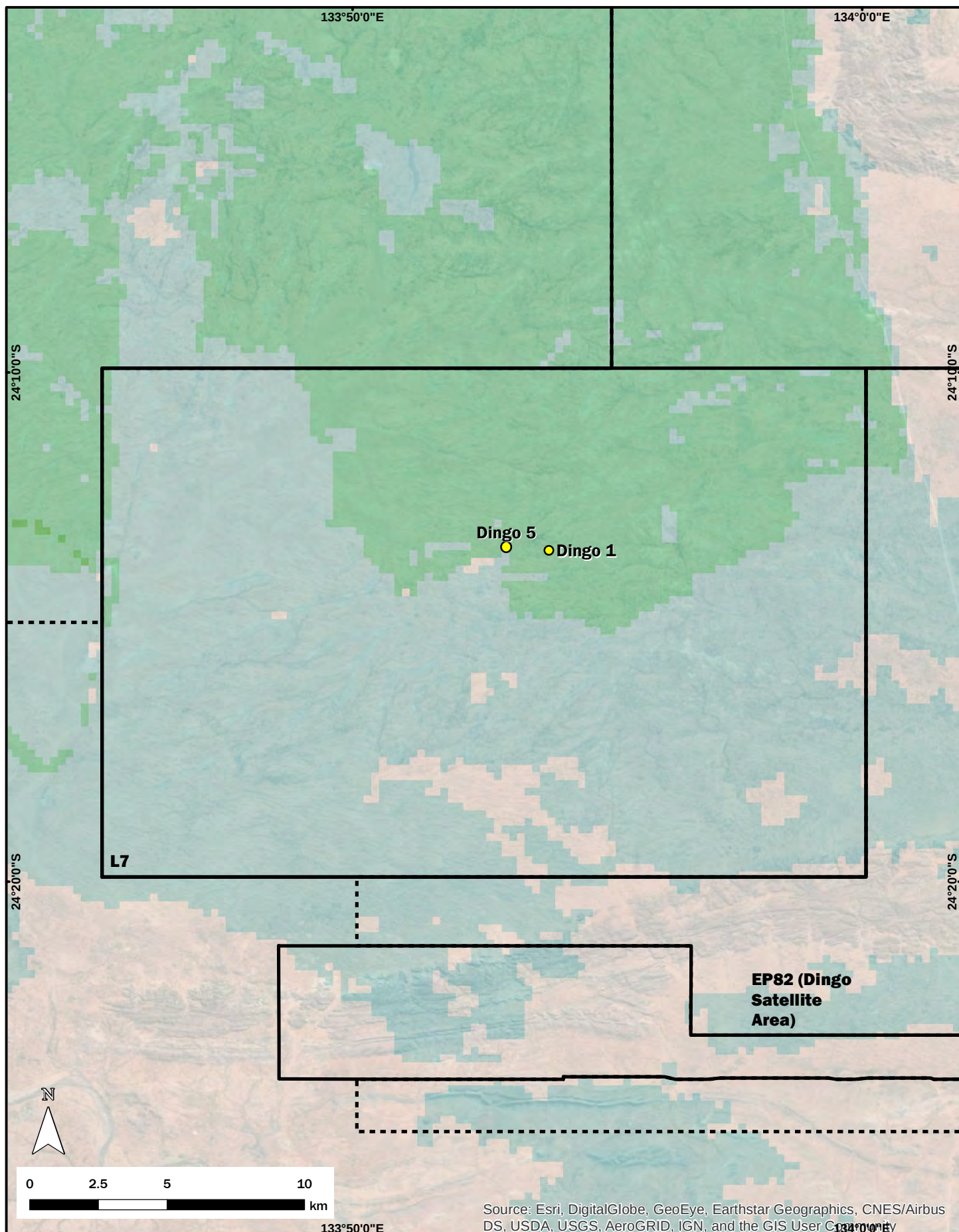
Table 5-11 provides an overview of the introduced fauna known to be within 50 km of the Dingo wells.

Table 5-11 Introduced Fauna (Dingo Wells)

Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey Result
Bird	Barbary Dove	<i>Streptopelia roseogrisea</i>	✓		
Bird	House Sparrow	<i>Passer domesticus</i>	✓		
Bird	Long-billed Corella	<i>Cacatua tenuirostris</i>	✓		
Bird	Rock Dove	<i>Columba livia</i>	✓		
Bird	Spotted Turtle-dove	<i>Spilopelia chinensis</i>	✓		
Mammal	Camel	<i>Camelus dromedarius</i>	✓	✓	✓
Mammal	Cat	<i>Felis catus</i>	✓	✓	✓
Mammal	Cattle	<i>Bos taurus</i>	✓		✓
Mammal	Fox	<i>Vulpes</i>	✓	✓	
Mammal	Horse	<i>Equus caballus</i>	✓	✓	
Mammal	House Mouse	<i>Mus musculus</i>	✓		
Mammal	Pig	<i>Sus scrofa</i>	✓		
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓	
Fish	Swordtail	<i>Xiphophorus hellerii</i>	✓		

5.1.2.9 Fire History

Northern Australia Fire Information (NAFI) records show fire frequency in the Dingo gas field is low with parts of the field having experienced between one and three fires since 2000 as seen in Figure 5-10. The most recent fires in 2011 burnt the majority of the Dingo gas field including the Dingo wells clearance area.



ID: 0523-11

Rev:

Date: 1/06/2020

Map Scale is 1:182,910 when printed at A4
Coordinate System: GCS GDA 1994

Fire frequency - Darwin Centre for Bushfire
Research 2020

Figure 5-10: Fire Scar Mapping (Dingo Wells)

- Indicative well location
- Permit
- Permit farmout area
- Years burnt 2000 - 2019
- Unburnt

- 1
- 2
- 3



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5.1.3 Socio-Economic Environment

An overview of the Dingo tenure and the locations of the Dingo wells in relation to populated places, roads, infrastructure and places of interests are provide in Figure 5-11.

5.1.3.1 Land Tenure

The proposed Dingo wells will be located within a single property, which details are provided in Table 5-12 . CP has existing relationships with the leaseholder through other petroleum infrastructure located on their property.

Table 5-12 Underlying land tenures

Property Name	Survey Plan Number	Land Tenure	Leaseholder	Primary Use
Orange Creek Station	CP5213	Perpetual Pastoral Lease	Wally Klein	Cattle Grazing

The L7 tenure is not located in a petroleum reserve block or proposed petroleum reserve block.

5.1.3.2 Surrounding Populated Places

Populated places close to the Dingo wells are:

- Alice Springs, approximately 60 km to the north
- Santa Teresa, approximately 40 km to the east
- Titjikala (Maryvale), approximately 40 km to the south
- Hermannsburg, approximately 100 km to the west.

5.1.3.3 Traffic

Traffic is discussed in Section 4.8.6, which indicates that traffic volumes associated with the project will be minor.

In addition, further controls are and will be in place to reduce the impact and keep other road users safe. All access tracks associated with the Dingo Gas Field are clearly signed for authorised vehicles only. The turn in and turn offs of NT controlled roads are currently being used by CP operations and no further upgrades are required. Where vehicles associated with the Project are causing significant dust on NT controlled roads, vehicle speeds will be reduced. Oversized loads will be accompanied by an accredited Pilot.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the Dingo wells.

5.1.3.4 Workforce

Workforce numbers for each activity during the drilling campaign are discussed in Section 4.2.

Due to the short nature of the activity, local resourcing strategy and utilisation of onsite drill rig operator camps the overall impact of the project should be positive to the local community. This assessment is based on the following:

- All contractors and employees will operate under a Pandemic (COVID-19) Management Plan which ensures here will be no direct interactions with vulnerable remote communities, pre-arrival assessment and daily monitoring of workers health, etc
- There will be no impacts on the demographics of the regional population from the drilling campaign

- CP will prioritise local resourcing, there will be contracts available and employment opportunities for a positive effect on the local business and services
- Housing and accommodation impacts will be minimised as the drill rig operator mobilises onsite camps for their own workforce. These camps are located away from communities and there will be no resulting adverse impacts.
- there will be a positive impact to lodging and services businesses in Alice Springs on crew change over days (expected 1 overnight in Alice Springs). Crew rotations will be managed to ensure that the services in Alice Springs are not overwhelmed and can continue to accommodate for tourists.
- Crews flying / driving in and out of Alice Springs will be bussed to the camp to reduce light vehicle traffic on regional roads
- CP will also explore opportunities to provide education and training opportunities to promote the gas industry, integrate the NT gas story into the tourism experience and include STEM (science, technology, engineering and mathematics) learning into local schools with technical experts and guided field trips to CP operations.

5.1.3.5 Cultural Heritage

5.1.3.5.1 Historic and Natural Heritage

The Dingo wells are located within the MacDonnell Shire. An online search of the NT heritage register showed 18 publicly listed heritage sites in the MacDonnell Shire, none of which are located in the within the Dingo wells clearance area. No non-public sites were found by the online search.

EPBC Protected Matters Search Tool reports for the Dingo wells did not identify any World Heritage Properties, National Heritage Places, Commonwealth Heritage Places or Places on the Register of National Estate within or within a 50km buffer of the Dingo wells (refer Appendix 2).

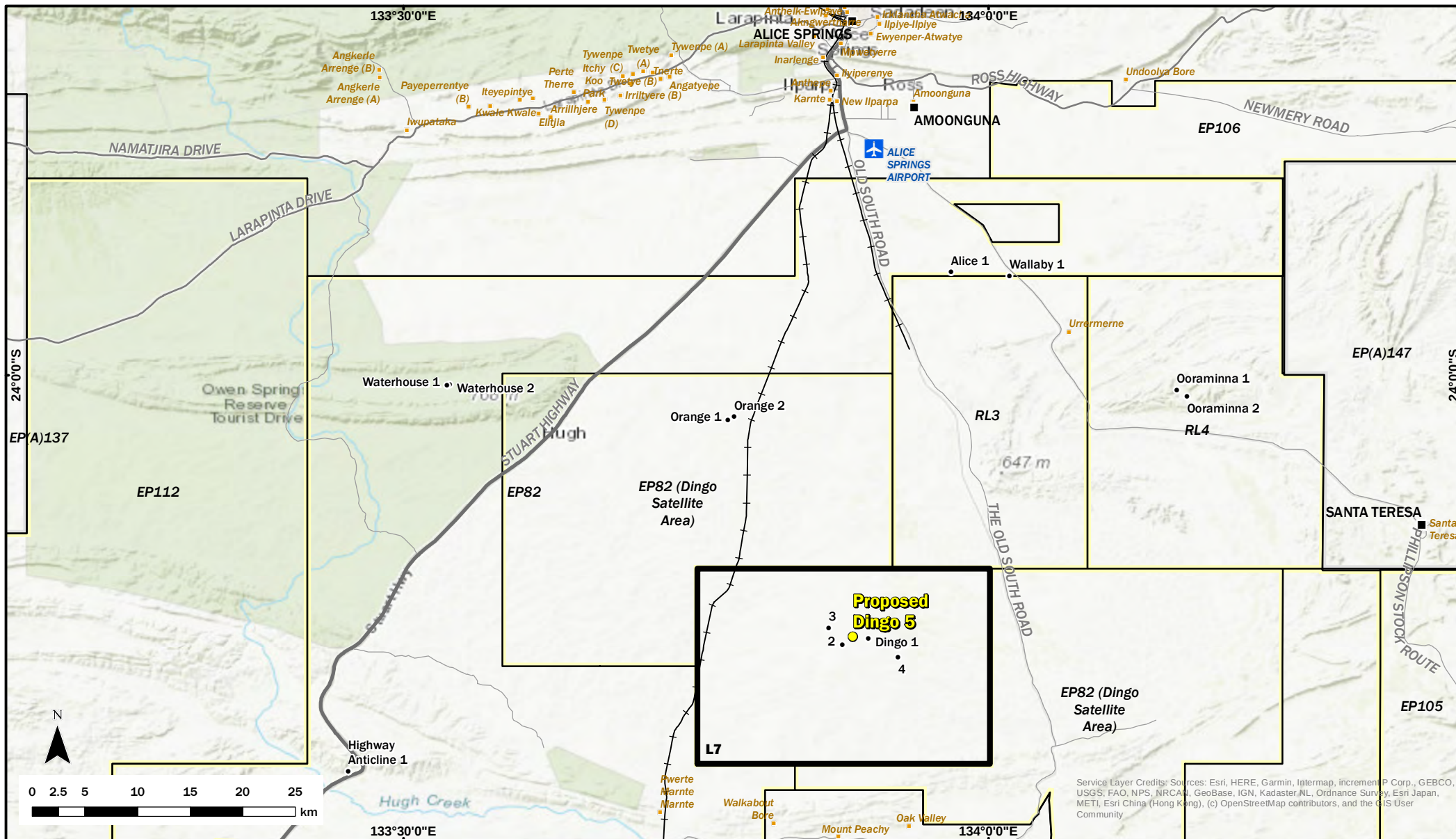
5.1.3.5.2 Aboriginal Archaeological Assessment

An Aboriginal archaeological assessment of the Dingo wells was undertaken by Everick Heritage in February 2020 to assess the potential impact of the drilling program on declared heritage places (i.e. all Aboriginal archaeological places) protected under the *Heritage Act 2011* (refer Appendix 3). Based on the findings of the assessment, the Dingo wells are not likely to impact on aboriginal archaeological places and no work approval under the Heritage Act 2011 is required.

The Everick Heritage report includes an Aboriginal Objects Find / Stop Work Procedure which CP will implement at the Dingo wells.

5.1.3.5.3 Aboriginal Sacred Sites

In accordance with the *Aboriginal Sacred Sites Act 1989*, CP has received an Authority Certificate from AAPA for the Dingo wells (Certificate #C2020/031). CP commits to complying with the requirements of the granted Authority Certificate. Additionally, CP will also obtain a Sacred Site Clearance Certificate from the Central Land Council for the Dingo wells.



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Rev: C
Date: 18/08/2020

Map Scale is 1:500,000 when printed at A4
Coordinate System: GCS GDA 1994

Source:
Aboriginal Communities - Department of
Infrastructure, Planning and Logistics 2020

Figure 5-11 Dingo 5 locality map

- Proposed Dingo 5
- Towns
- ✈ Airport
- Petroleum Wells
- Aboriginal Communities
- ▭ L7
- Railway
- Minor Road
- Principal Road
- Secondary Road
- ▭ CTP Permit Application
- ▭ CTP Granted Permit

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5.2 West Mereenie Wells

5.2.1 Physical Environment

5.2.1.1 Climate

The proposed well sites experience an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable.

Climate data has been summarised using all available data from the nearest Bureau of Meteorology weather station to the wells (015652, Watarrka) and Table 5-13 shows the mean maximum and minimum temperature, mean rainfall, highest rainfall, lowest rainfall, mean days of rain and mean evaporation for each month.

Table 5-13 Climate Data (West Mereenie Wells)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	38.4	36.9	35.1	30.7	24.9	21.3	21.9	24.4	29.4	33.2	35.1	36.7
Mean minimum temperature (°C)	23.5	23.0	20.8	16.7	10.8	6.4	6.1	8.1	13.1	17.5	19.7	22.1
Mean rainfall (mm)	45.7	39.8	29.2	13.3	22.1	14.7	13.4	6.0	10.0	24.6	45.0	37.3
Highest rainfall (mm)	185.0	377.8	237.2	161.6	158.1	133.5	82.5	38.9	104.9	123.7	168.5	103.9
Lowest rainfall (mm)	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Mean days of rain	5.6	4.9	3.0	2.6	3.3	2.5	2.5	1.6	2.7	4.0	6.5	7.3
Mean evaporation (mm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

5.2.1.2 Regional Geology

The proposed West Mereenie wells are located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km² and a maximum sediment thickness of 14 000m with several major depocentres including the Idirriki, Carmichael and Ooraminna Sub-basins and Missionary Plain Trough along the northern margin and the Mount Currie and Seymour Sub-basins in the south (Geoscience Australia, 2020). It is bound in the north by the Arunta complex and in the south by the MusgraveMann complex, both containing granite, gneiss and schists, with amphibolite and quartzite.

The stratigraphy of the region is shown in Figure 5-1.

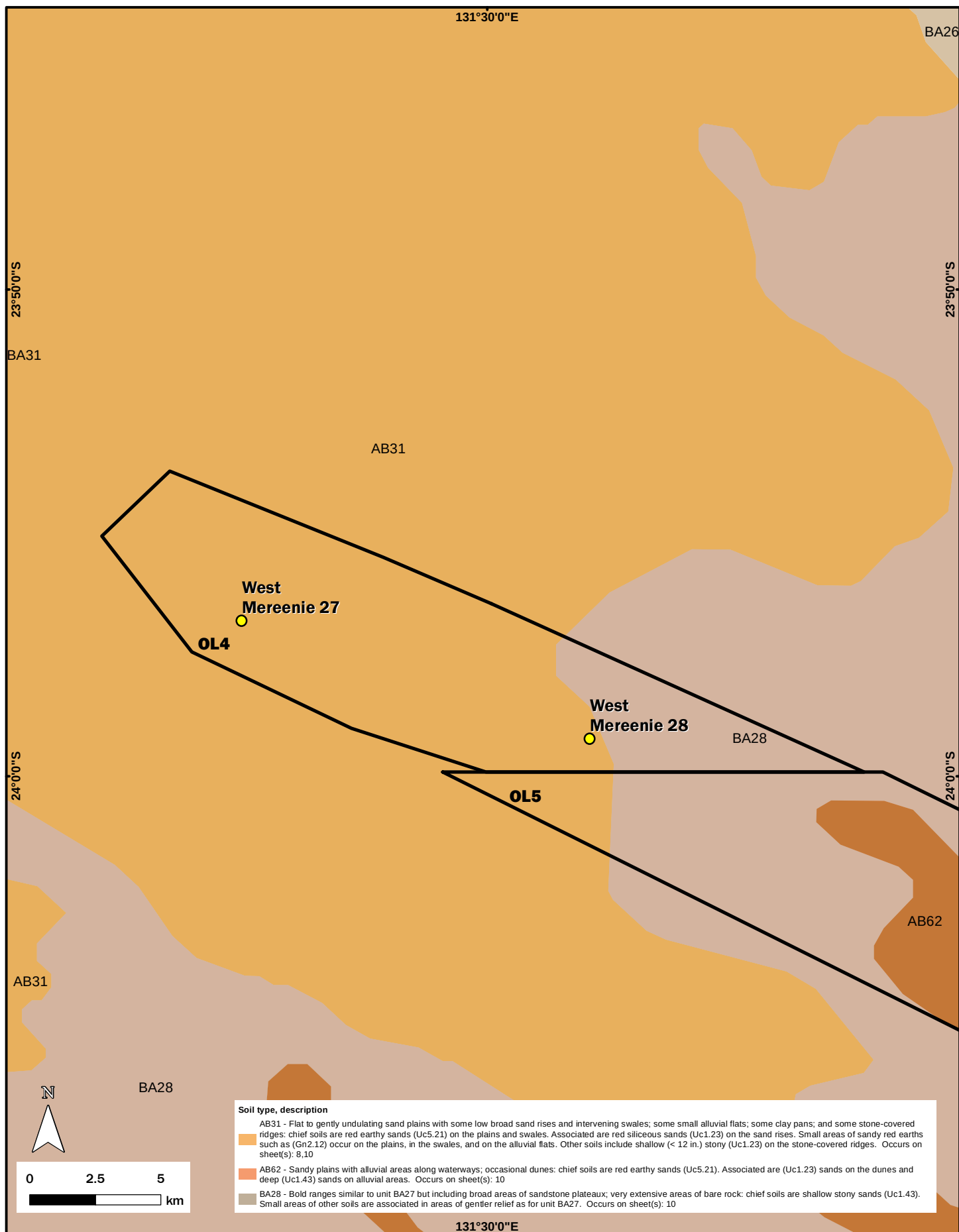
5.2.1.3 Regional Soils

Three soil types, as mapped using data from the Digital Atlas of Australian Soils (based on Northcote, et al., 1960-1968) are present within the wider West Mereenie field. Table 5-14 provides a description of these soil types with Figure 5-12 Soil Types (West Mereenie Wells) showing the location of the West Mereenie wells relative to the soil types.

The West Mereenie wells are located within the AB31 soil type.

Table 5-14 Description of soils units (West Mereenie Wells)

Soil Type	Landform	Soils
AB31	Flat to gently undulating sand plains with some low broad sand rises and intervening swales; some small alluvial flats; some clay pans; and some stone-covered ridges	Chief soils are red earthy sands on the plains and swales. Red siliceous sands on the sand rises. Small areas of sandy red earths occur on the plains, in the swales and on the alluvial flats. Other soils include shallow stony on the stone covered ridges
AB62	Sandy plains with alluvial areas along waterways; occasional dunes	Chief soils are red earthy sands
BA28	Bold ranges, ridges, cuestas, and hills on sandstones and quartzites. Extensive areas of bare rock	Chief soils are shallow stony sands



ID: 0523-06
 Rev:
 Date: 20/10/2020
 Map Scale is 1:191,040 when printed at A4
 Coordinate System: GCS GDA 1994
 Digital Atlas of Australian Soils - 1991

Figure 5-12: Soil Units (West Mereenie Wells)

- Indicative well location
- Permit



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5.2.1.4 Land Systems

A land system is an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1968). Land system descriptions provide a general and consistent basis for determining potential habitat types present within the region of the survey areas. Land system mapping available for the West Mereenie wells is at a scale of 1:1,000,000 (Perry et al. 1962).

The West Mereenie wells are located within the Simpson land system as shown in Figure 5-13 and described in Table 5-15 .

Table 5-15 Land System (West Mereenie Wells)

Land System	Landform Class	Description
Simpson	Desert dunefields	Spinifex-covered sand dunes. Dunefields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.

5.2.1.5 Land Types

Land types build upon the land systems described in Section 5.2.1.4 and are a mapping unit that delineate areas of similar landform, soils and vegetation to a reasonable level of detail and accuracy. Land types within the West Mereenie well locations have been mapped at a scale of 1:5000 and are based on surveys conducted during February 2020.

Eleven land types were identified within the West Mereenie wells as described in Table 5-16 and shown in Figure 5-14 and .Figure 5-15.

Table 5-16 Land Types (West Mereenie Wells)

Land type	Description	Representative photograph
WM27-A	Flat to undulating sandplain and dune swales with small sandstone outcrops. Aeolian red siliceous sands and red earths. Open shrubland of <i>Acacia melleodora</i> and <i>Eremophila latrobei subsp. latrobei</i> over spinifex (<i>Triodia schinzii</i>) with occasional emergent trees (<i>Corymbia chippendalei</i>, <i>Allocasuarina decaisneana</i>, <i>Brachychiton gregorii</i>). Outcrops support tussock grasses (<i>Aristida holathera</i> var. <i>holathera</i>, <i>Eriachne helmsii</i> and <i>Eragrostis eriopoda</i>) with shrubland of <i>Senna artemisioides subsp. artemisioides</i>, <i>Acacia ayersiana</i> and <i>Acacia aneura</i>. <i>Triodia schinzii</i> yet to regenerate after recent fire (low rainfall). Small forbs (including <i>Scaevola basedowii</i> and <i>Leptosema chambersii</i>) were more common. Sandplains near dunes support dune specialist species. Fire in most parts of sandplain in 2011, fire <2 years ago burnt swales in south eastern part of survey area.	
WM27-B	Sand dune and dune flanks (<10m relief) Aeolian red siliceous sands. Open shrubland of <i>Acacia melleodora</i> and <i>Grevillea stenobotrya</i> over spinifex (<i>Triodia schinzii</i>). Other common species are <i>Chrysocephalum eremaeum</i>, <i>Dampiera cinerea</i> and <i>Calotis erinacea</i>. Patches of <i>Aluta maisonneuvei subsp. maisonneuvei</i> on dune flanks. Sporadic emergent trees (<i>Corymbia chippendalei</i> and <i>Allocasuarina decaisneana</i>). Spinifex absent or regenerating after recent fire. Small sub-shrubs/forbes (e.g. <i>Scaevola basedowii</i> and <i>Leptosema chambersii</i>) dominate burnt areas Fire in most parts of the flanks in 2011, fire <2 years ago burnt south eastern part of survey area.	

Land type	Description	Representative photograph
WM27-C	Mulga on localised areas of sandstone outcrop and laterised gravel. Sandy red earth soils; likely shallow. Patchy low woodland to low open woodland of <i>Acacia aneura</i> and <i>Acacia ayersiana</i>. Common shrubs include <i>Eremophila latrobei</i> subsp. <i>glabra</i> and <i>Senna artemisioides</i> subsp. <i>artemisioides</i>. Ground layer is sparse in the red earth areas with <i>Eriachne helmsii</i> and <i>Eragrostis eriopoda</i> being most common species. Little mulga regeneration observed. Avoided 2011 fire, last fire is approx. 10-20 years which appears to have burnt edges of the patch.	
WM28-A	Tussock grass sandy red earth plains and rises. Sandy red earth soils. Patchy tall shrubland of <i>Acacia aneura</i>, <i>Acacia ayersiana</i> and <i>Eucalyptus gamophylla</i> over scattered low shrubs (mainly <i>Eremophila latrobei</i> subsp. <i>latrobei</i>, <i>Psyrax latifolia</i> and <i>Acacia ramulosa</i> var. <i>ramulosa</i>) with a tussock grass dominant ground layer (mainly <i>Eragrostis eriopoda</i> subsp. Red earth). Occasional <i>Eucalyptus intertexta</i>.	
WM28-B	Spinifex red earth sandplains and sandy rises. Soils vary from sandy red earth to aeolian red siliceous sands. Open to sparse shrubland of <i>Eucalyptus gamophylla</i> +/- <i>Acacia kempeana</i> and <i>Acacia aneura</i> over spinifex (<i>Triodia schinzii</i>). Other common shrubs include <i>Grevillea juncifolia</i> subsp. <i>juncifolia</i>, <i>Psyrax latifolia</i>, <i>Acacia maitlandii</i>, <i>Senna artemisioides</i> subsp. <i>artemisioides</i>, <i>Aluta maisonneuvei</i> subsp. <i>maisonneuvei</i>, <i>Eremophila willsii</i> subsp. <i>Kata Pata</i>, <i>Jasminum calcareum</i>). Uncommon emergent <i>Allocasuarina decaisneana</i> (mostly only young trees present) Last fire estimated at 20 years.	

Land type	Description	Representative photograph
WM28-C	Red earth depression / swale Clayey red earth; localised run-on areas. Low woodland of <i>Acacia aneura</i>, <i>Acacia aptaneura</i> and <i>Acacia ayersiana</i> with sparse shrubs (<i>Eremophila latrobei</i> subsp. <i>latrobei</i>, <i>Psydrax latifolia</i> and <i>Psydrax ammophila</i>) over a scattered cover of tussock grasses (common species include <i>Aristida inaequiglumis</i>, <i>Eragrostis eriopoda</i> subsp. <i>Red earth</i> and <i>Digitaria brownii</i>). Long-time unburnt.	
WM28-D	Sandstone hill (~ 10m relief) with a rocky breakaway area on the eastern side; transitions into a gravel plain to the west. Skeletal soils; shallow pale brown sandy loam. Open shrubland of <i>Acacia macdonnellensis</i> subsp. <i>macdonnellensis</i> over spinifex (<i>Triodia melvillei</i>). Shrub layer is relatively sparse with commonly encountered species <i>Psydrax latifolia</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i>. Emergent trees (isolated) <i>Corymbia eremaea</i>. Last fire estimated at 20 years.	
WM28-E	Gravelly (laterised) sandstone rise (flat). Sandy loam (likely shallow) with fine to pebbly laterised gravel. Open to sparse shrubland of Mulga hybrid <i>Acacia aneura</i> x <i>Acacia minyura</i> over sparse tussock grasses (mainly <i>Eragrostis eriopoda</i> and <i>Eriachne mucronata</i>). Other less common species include <i>Senna artemisioides</i> subsp. <i>artemisioides</i>, <i>Psydrax suaveolens</i>, <i>Psydrax latifolia</i>, <i>Ptilotus obovatus</i> var. <i>obovatus</i>. An unknown form of <i>Acacia aneura</i> (likely hybridised) was encountered in this land type. Last fire estimated at 20 years.	
WM28-G	Spinifex sand dunes; low relief. Red siliceous sands Patchy shrubland of <i>Aluta maisonneuvei</i> subsp. <i>maisonneuvei</i>, <i>Eucalyptus gamophylla</i> over spinifex (<i>Triodia schinzii</i>) and <i>Chrysocephalum eremaeum</i>. Other common species include <i>Acacia ligulata</i>, <i>Acacia melleodora</i>, <i>Grevillea juncifolia</i> subsp. <i>juncifolia</i>, <i>Goodenia mueckeana</i>, <i>Eremophila willsii</i> subsp. <i>Kata Pata</i>, <i>Leucochrysum stipitatum</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i>. Sporadic emergents <i>Allocasuarina decaisneana</i> and <i>Corymbia chippendalei</i>. Last fire estimated at 20 years.	

Land type	Description	Representative photograph
WM28-H	Sandy rise. Red siliceous sands and sandy red earths. Low shrubland of <i>Aluta maisonneuvei</i> subsp. <i>maisonneuvei</i> over scattered spinifex (<i>Triodia schinzii</i>). Only generally present in small isolated patches, or at the base of sand dunes.	

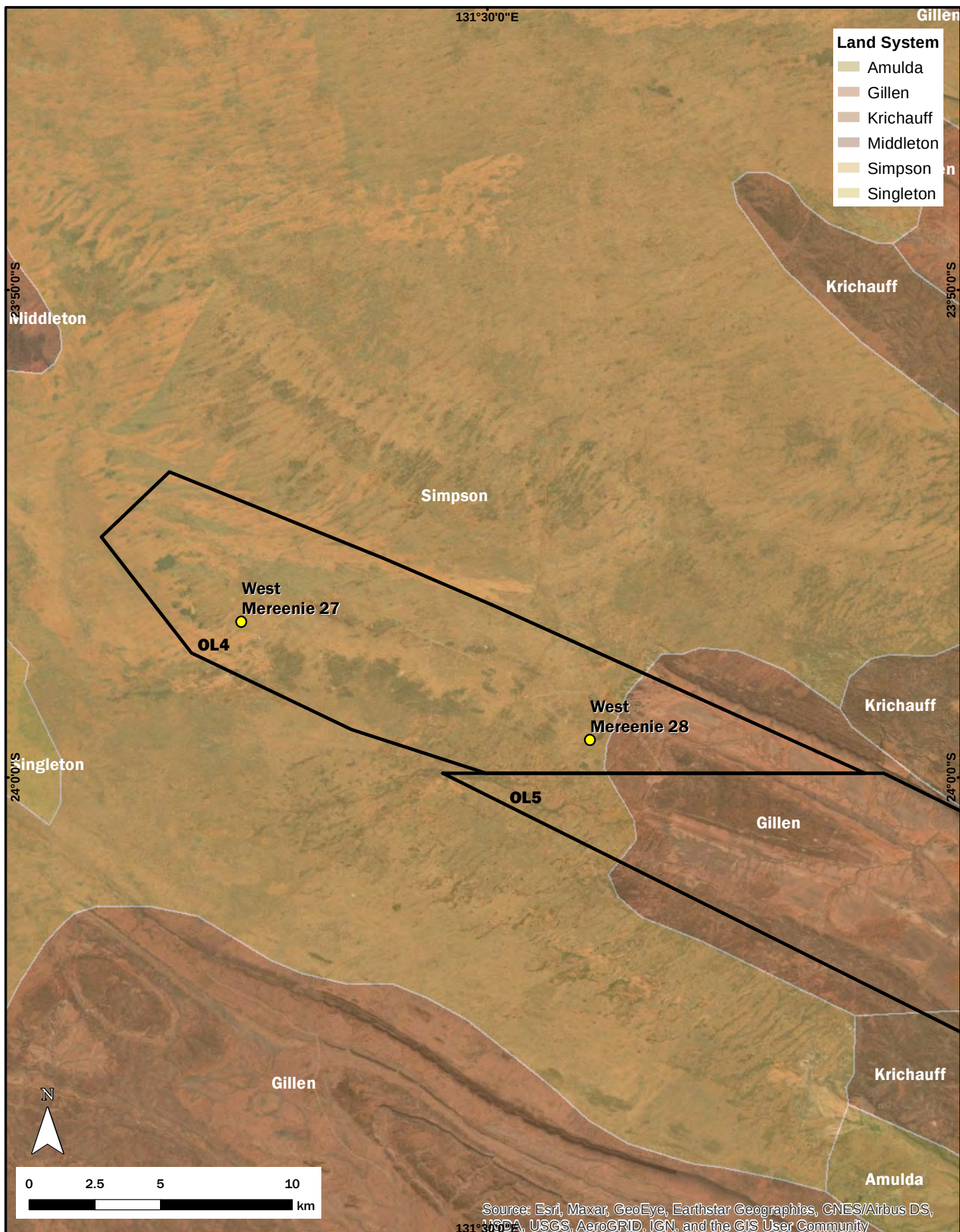


Figure 5-13: Land Systems (West Mereenie Wells)

- Indicative well location
- Permit



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Date: 20/10/2020

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Coordinate System: GCS GDA 1994

Land Systems - Department of Environment and
Natural Resources



WEST MEREENIE 27

Survey information

- Survey area (well pad)
- Survey area (access and pipelines)
- Check sites
- Survey transects
- Existing underground pipeline
- Existing tracks or seismic lines

Land types (1:5,000) (ground-truthed)

WM27-A: undulating sandplain with an open shrubland of *Acacia melleodora* and *Eremophila latrobei* subsp. *latrobei* over spinifex (*Triodia schinzii*) with occasional emergent trees. Scattered areas of localised sandstone outcrop.

WM27-B: sand dunes (<10m height) with open to sparse shrubland of *Acacia melleodora* and *Grevillea stenobotrya* over spinifex (*Triodia schinzii*). Scattered emergent *Allocasuarina decasneana* and *Corymbia chippendalei*.

WM27-C: Low outcrop and laterised gravel with patchy low woodland of *Acacia aneura* and *Acacia ayersiana* over tussock grasses.



0 37.5 75 150
Metres



MAP INFORMATION

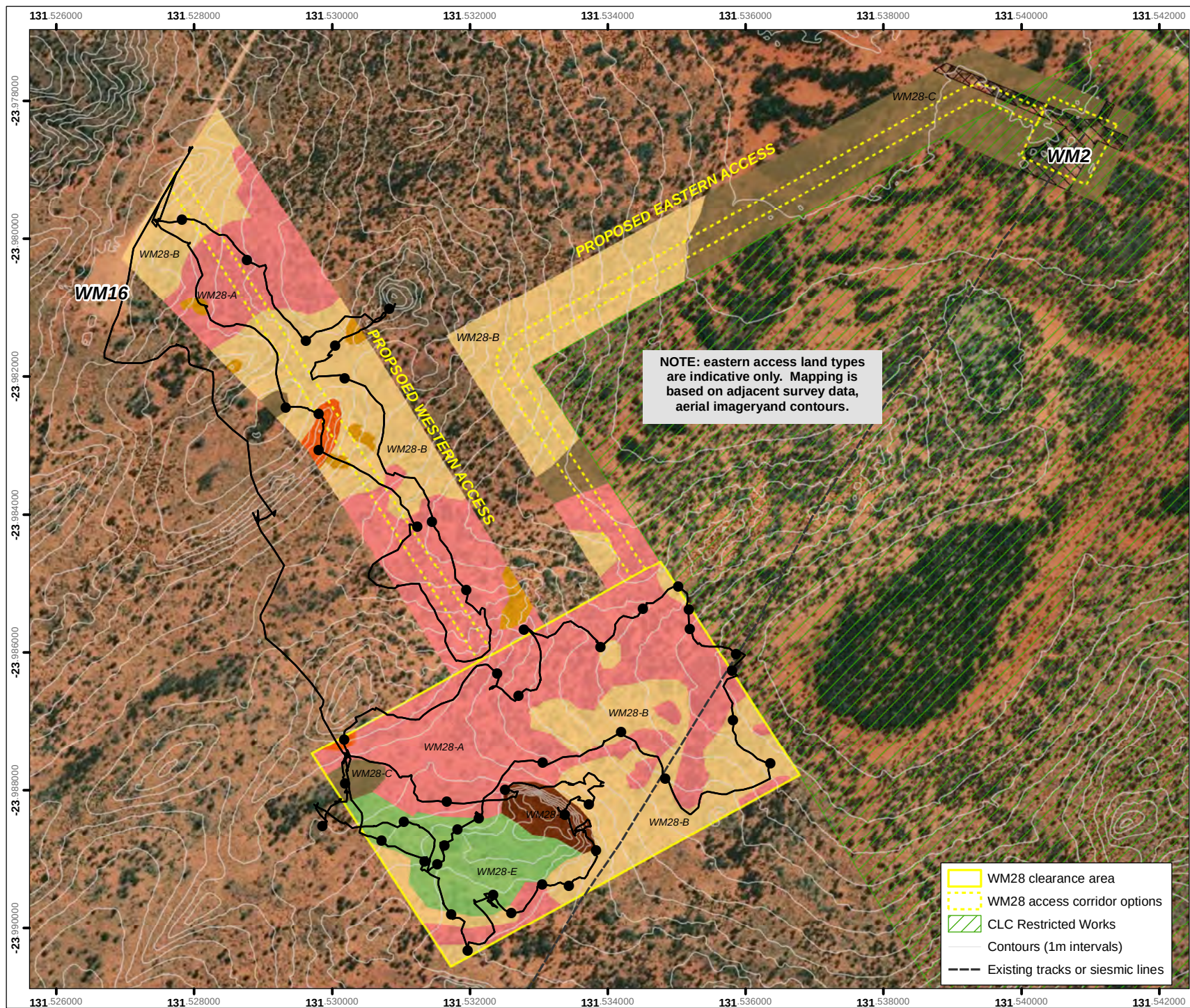
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Projection: GCS GDA 1994
Date Saved: 15/10/2020
Client: Enviro-Value
Author / Mapper: TR

DATA SOURCE

Survey area: EcOz (based on client)
Survey data: EcOz (Feb 2020)
Imagery: Maxar (24/8/2018)

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

Figure 5-14. Land types within the WM27 clearance area



WEST MEREEENIE 28

Land types (1:5,000) (ground-truthed)

- Check sites
- Survey transect
- WM28-A: undulating sandy red earths with a patchy tall shrubland of *Acacia aneura*, *Acacia ayersiana* and *Eucalyptus gamophylla* over tussock grass
- WM28-B: sandy red earth plains / rises with open to sparse shrubland of *Eucalyptus gamophylla* +/- *Acacia kempeana* and *Acacia aneura* over spinifex (*Triodia schinzii*)
- WM28-C: red earth depression / swale with *Acacia aneura*, *Acacia aptaneura* and *Acacia ayersiana* over scattered tussock grasses
- WM28-D: sandstone hill (with breakaway) with an open shrubland of *Acacia macdonnellensis* over spinifex (*Triodia melvillei*)
- WM28-E: gravel plain with an open to sparse shrubland of Mulga hybrid *Acacia aneura* x *Acacia minyura* over sparse tussock grasses
- WM28-G: sand dunes with a patchy shrubland of *Aluta maisonneuvei* subsp. *maisonneuvei*, *Eucalyptus gamophylla* over spinifex (*Triodia schinzii*) and *Chrysocephalum eremaeum*
- WM28-H: sandy rises with an open shrubland of *Aluta maisonneuvei* subsp. *maisonneuvei*
- Disturbed (Cross-hatched pattern)



0 55 110 220
Metres



MAP INFORMATION
Scale: 1:8,500 @ A4
Projection: GCS GDA 1994
Date Saved: 5/06/2020
Client: Enviro-Value
Author / Mapper: TR

DATA SOURCE
Survey area: Central Petroleum
Survey data: EcOz (Feb 2020)
Imagery: Maxar (18/8/2018)

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

Figure 5-15. Land types present within the WM28 clearance area

5.2.1.6 Groundwater

The West Mereenie wells are located within Mereenie Field which is within the Amadeus Basin, an elongated east-west aligned sedimentary basin that covers an area of approximately 170 000 km² in central Australia. Lloyd and Jacobson (1987) define two main hydrogeological domains within the Amadeus Basin: the north-central area has broad folding associated with extensive and mappable sandstone formations, elsewhere in the basin greater deformation has resulted in the development of a regional fractured rock groundwater systems.

The Mereenie Field is located in the north-central area of the Amadeus Basin. Lloyd and Jacobson (1987) describe that the area includes a series of stacked regional scale formations that have good groundwater supply potential. These include the Hermannsburg Sandstone, Mereenie Sandstone and the Pacoota Sandstone.

Locally, the West Mereenie wells are situated over a prominent north-west to south-east orientated anticline. The surface geology in the vicinity of the wells is characterised by a thin veneer of Quaternary dune sands and alluvial sediments (Figure 5-16). These overlie and interfinger with the Mereenie Sandstone, which outcrops along the exposed hinge of the anticline. Exposures of Parke Siltstone and Hermannsburg Sandstone occur to the north-east and south-west, however, these formations have been eroded off the hinge of the anticline and are not present beneath the West Mereenie wells.

The Mereenie Sandstone is a loose, fine to very coarse-grained quartz sandstone that reaches a thickness of around 300 m in the vicinity of the West Mereenie wells and hosts the water table beneath the well sites. It is a regionally extensive formation and is of particular significance in the north-east of the Amadeus Basin where it provides the water supply for Alice Springs. The regional groundwater flow direction in the Mereenie Sandstone around the West Mereenie wells is to the east (Lloyd and Jacobson, 1987). Bore yields of up to 100 L/s have been recorded in the aquifer at Roe Creek (Alice Springs), though this is attributed to very high secondary permeability (Macqueen and Knott, 1982) and is not representative of the formation regionally.

Locally, Jameison and Wischusen (1998) class the formation as having moderate bore yields (1 – 5 L/s) while Read (2007) reports on range of 1.5 – 10 L/s from 15 bores. Water quality is variable but in the vicinity of the West Mereenie wells is of good potable drinking water quality¹¹ Read (2007) suggests that diffuse recharge accounts for the majority of active recharge to aquifer and estimated rates are in order of 1 mm/year. Transmissivities of up to 4,000 m²/day have been observed in the Mereenie Sandstone though 600 m²/day is considered representative for the aquifer at a regional scale (Macqueen and Knott, 1982).

The Mereenie Sandstone overlies and is in limited hydraulic connection with the Carmichael Sandstone (Lloyd and Jacobson, 1987), which comprises interbedded sandstone, siltstone and mudstone. The formation contains limited groundwater resources and is of notably lower permeability than the overlying Mereenie Sandstone.

Underlying the Carmichael Sandstone is the Stokes Siltstone, which locally is in excess of 300 m thick and forms a reservoir seal that isolates gas resources in the underlying Stairway Sandstone from the Mereenie Sandstone aquifer. The Pacoota Sandstone underlies the Horn Siltstone, which separates it from the overlying Stairway Sandstone.

The Pacoota Sandstone is both a gas and oil reservoir within the Mereenie field. Lloyd and Jacobson (1987) report that saline and overpressure groundwater underlies the oil resource in the Pacoota Sandstone. Regional groundwater gradients in the Pacoota Sandstone are to the east, however, local flow directions in the vicinity of the Mereenie field are complex, as a result of compartmentalisation of the hydraulic connectivity due to cross faulting (Lloyd and Jacobson (1987)).

¹¹ Good palatability in drinking water has a TDS of <600 mg/L (NHMRC, NRMCC 2011), bores near WM27 have an average TDS of 400 mg/L

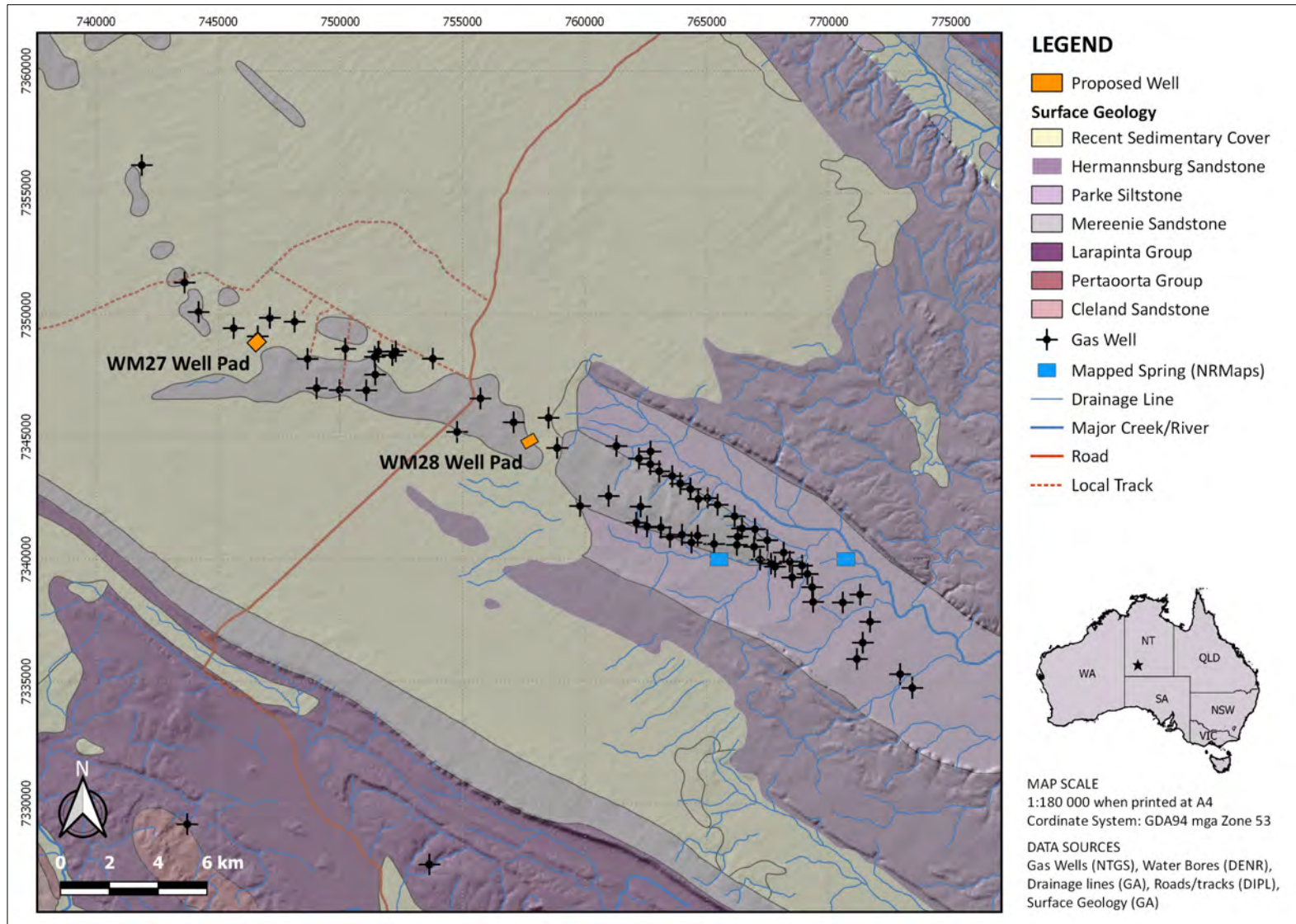


Figure 5-16 Surface Geology (West Mereenie Wells)

Table 5-17 provides a summary of the formation depths, thickness and groundwater potential of formations beneath the West Mereenie wells from the surface to the Pacoota Sandstone.

Table 5-17 Summary of Stratigraphy and Groundwater Occurrence (West Mereenie Wells)

Formation	Depth WM27 / WM28* (mBGL)	Thickness WM27 / WM28* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Mereenie Sandstone	Surface	320 / 240	Porous quartz sandstone	Good potential for useable groundwater supplies across the region	Fresh	Yes
Carmichael Sandstone	330 / 380	90 / 60	Interbedded sandstone, siltstone and mudstone	Limited potential for useable groundwater supplies	Not known	Yes
Stokes Siltstone	420 / 440	340 / 320	Claystone, siltstone	Poor	Not Known	No
Stairway Sandstone	760 / 760	310 / 250	Silty sandstone with interbedded siltstone	Gas Reservoir	Not known	No
Horn Valley Siltstone	1,070 / 1,010	110 / 80	Claystone with interbedded marl and limestone	Poor	Not known	No
Pacoota Sandstone	1,180 / 1,090	>400 / >220	Quartz sandstone with minor claystone	Oil / Gas Reservoir	Saline	No

*Data based on WM27 prognosis and the completion report for WM28

^ Water quality assessment is based on existing bore data and the regional sources

5.2.1.6.1 Groundwater Bores

A search of NR Maps¹² identified the following registered groundwater bores and details within a 10 km radius of the West Mereenie wells:

- Three current groundwater bores (two located within 5 km) for the West Mereenie-27 well (see Figure 5-17)
 - All three bores are constructed in the Mereenie Sandstone with bore depths between 148 – 277 mBGL and a water level range of 59 – 169 mBGL
 - The groundwater is of good potable quality with an EC range of 360 – 450 $\mu\text{S}/\text{cm}$
- Nine current groundwater bores (seven located within 5 km) for the West Mereenie-28 well (see Figure 5-18)
 - Four of these bores (RN13862, RN013863, RN005220 and RN013389) were abandoned without construction or are associated with oil exploration wells
 - The remaining five bores screen the Mereenie Sandstone aquifer with construction depths of 192 – 281 mBGL, water levels ranging from 159 – 190 mBGL and EC of 360 – 800 $\mu\text{S}/\text{cm}$.

¹² <https://nrmaps.nt.gov.au/>

Table 5-18 provides an overview of each of the current registered groundwater bores within 10 km of the West Mereenie wells.

For the period 2017 to 2020, CP has extracted between 34.1 ML/year and 47.4 ML/year from the water supply bores in the Mereenie field. In accordance with amendments to the Water Act (1992), CP has applied for a Water Extraction License for the Mereenie Oil and Gas Field for an annual volume of 52.8 ML from bores RN018955, RN017657, RN017898, RN004620 and RN013861¹³. This water is required for operational needs, inclusive of workover activities, track maintenance and camp supplies. (EcOz, 2020). The only other water supply bore within 10km of the well sites is a NT Government bore that is used intermittently for road maintenance. A total of 1.1 ML is estimated to be required per well for the civil construction, drilling and camp requirements for West Mereenie 27 and 28 (Table 4-4). The entire duration of the campaign for the two wells is estimated at 34 days for civil works and drilling when the water would be utilised (Table 4-2). The most intensive usage is during drilling, which equates to an average extraction rate of 0.87 L/s over the duration of drilling. The Theis (1935) solution was used to estimate the drawdown after 20 days of continuous use at this rate from a single bore (Figure 5-19). This analysis indicates that drawdown will not exceed 0.1 m beyond a distance of approximately 200m from the extraction bore. The hydraulic parameters used in the assessment are shown on Figure 5-19.

The Mereenie field is not located within a NT Government groundwater management area.

Historical time series groundwater level data is not available for aquifers in the vicinity of the Mereenie field. The closest monitoring bores are located in the Kings Canyon region over 20 km to the south-west of the West Mereenie wells.

Table 5-18 Summary of Registered Bores within 10 km (West Mereenie Wells)

Bore ID	Distance to WM27 / WM 28 (km)	Aquifer#	Drilled depth (mBGL)	Groundwater		Sampled in previous baseline assessments	Status
				EC ($\mu\text{S/cm}$)	Depth to water (mBGL)		
RN018955	2.4 / 9.9	Mereenie Sandstone	192	360 [^]	159	yes	CP water supply bore
RN004619	3.7 / -	Mereenie Sandstone	148	960 [^]	52	-	Abandoned water bore
RN016361	8.0 / 3.4	Mereenie Sandstone	277	450	169	-	Northern Territory government roads bore
RN017657	- / 2.3	Mereenie Sandstone	227	800	190	yes	CP camp water supply bore
RN013862	- / 2.9	No water intersection	-	-	-	-	Abandoned, Not cased
RN013863	- / 2.9	No water intersection	-	-	-	-	Abandoned, Not cased
RN017898	- / 3.0	Mereenie Sandstone	236	440 [^]	164	yes	CP water supply bore
RN013864	- / 3.1	Mereenie Sandstone	281	850	183	-	Not known
RN005220	- / 3.2	-	-	-	-	-	East Mereenie 3 well

¹³ RN004620 and RN013861 are greater than 10km from the WM27 or WM28

Bore ID	Distance to WM27 / WM 28 (km)	Aquifer#	Drilled depth (mBGL)	Groundwater		Sampled in previous baseline assessments	Status
				EC (μ S /cm)	Depth to water (mBGL)		
RN013389	- / 9.1	-	-	-	-	-	East Mereenie 5 well

Based on interpretation of driller's log and surface geology

^ EC based on TDS using a conversion factor of 0.65

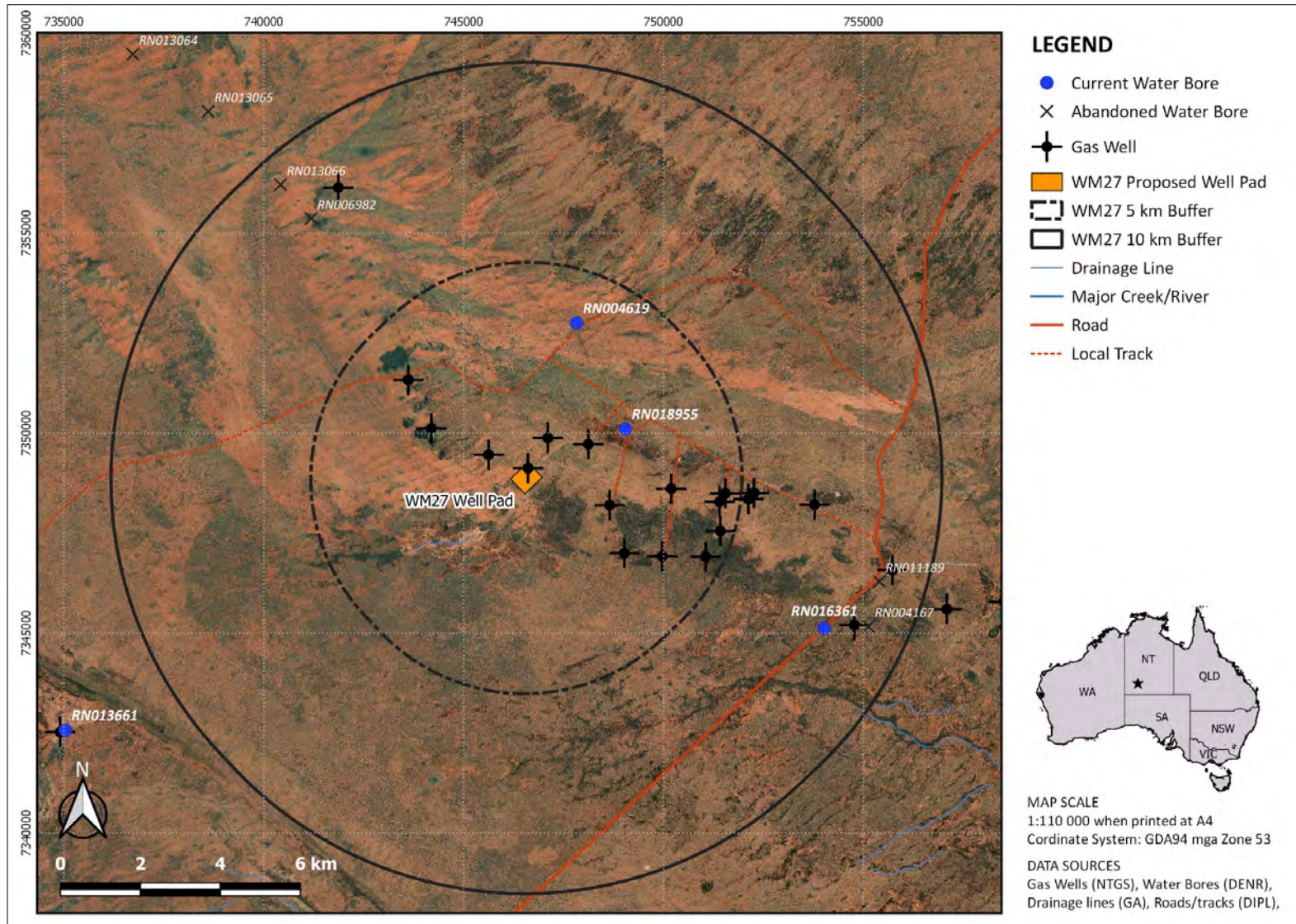


Figure 5-17 Registered Groundwater Bores within 10 km (West Mereenie-27 Well)

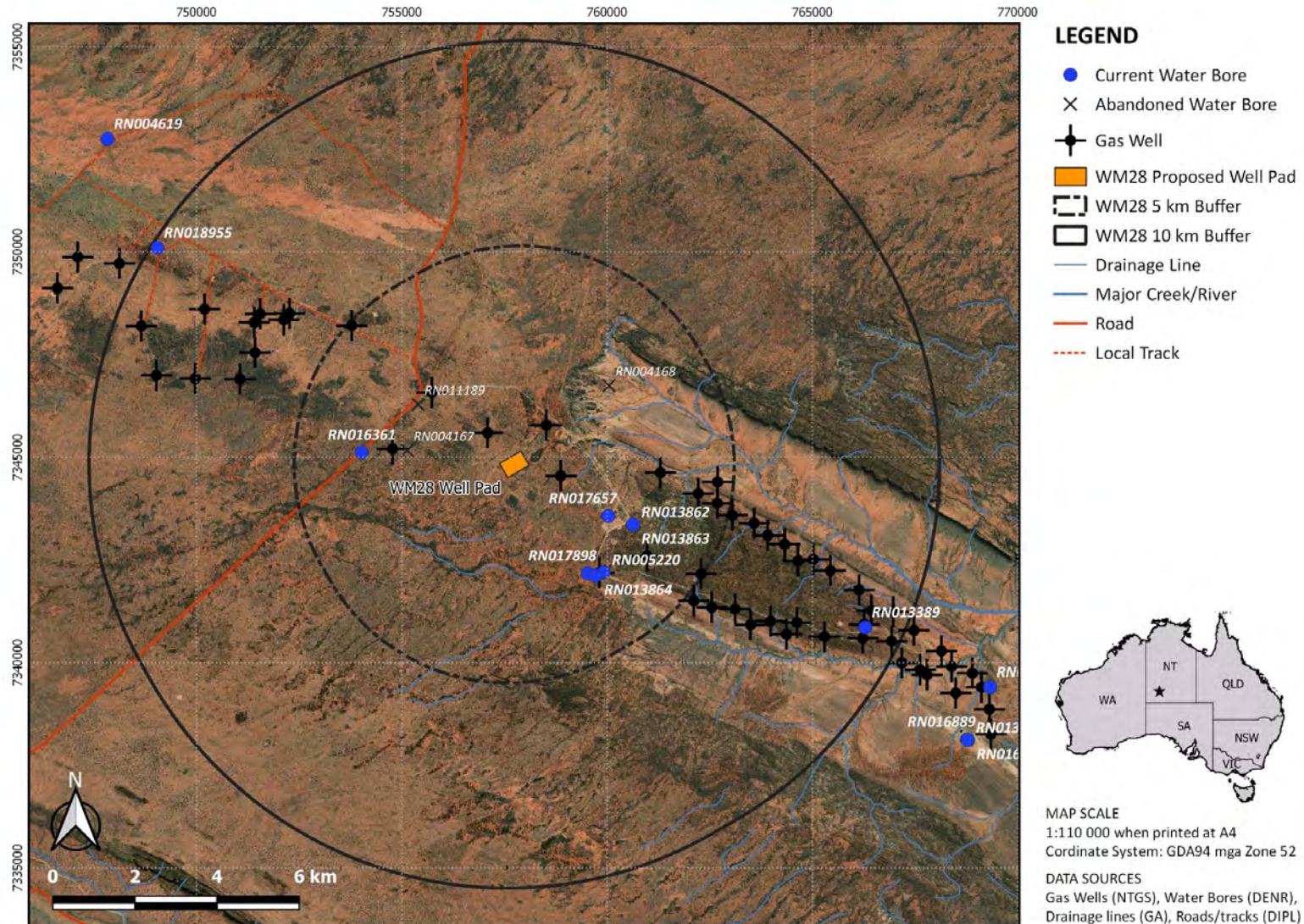


Figure 5-18 Registered Groundwater Bores within 10 km (West Mereenie-28 Well)

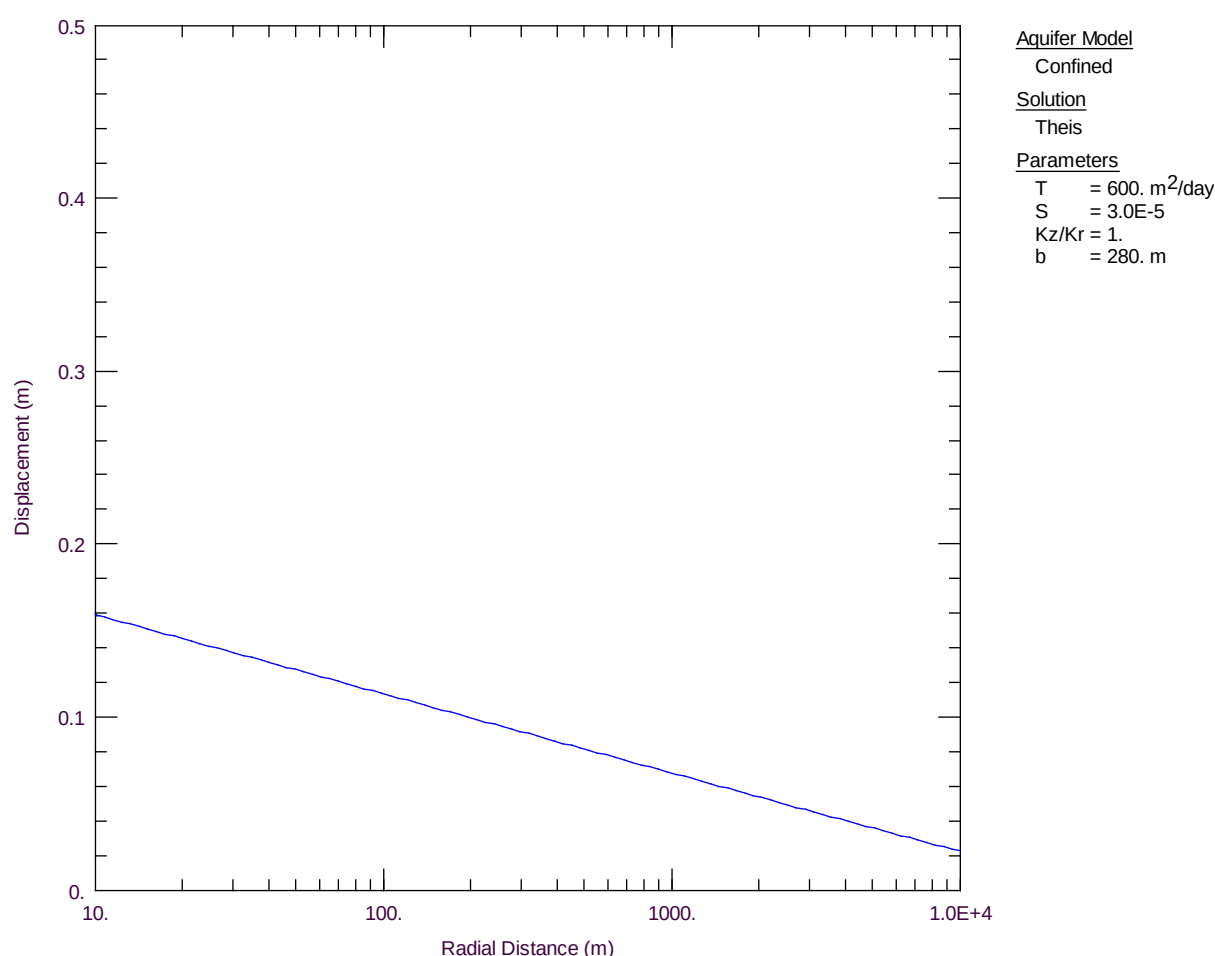


Figure 5-19 Distance-drawdown prediction for groundwater extraction associated with the West Mereenie 27 and 28 drilling

5.2.1.6.2 Baseline Groundwater Sampling

Baseline groundwater samples were collected from RN018955 and RN016361, the closest bores to the West Mereenie wells, in March 2020. The bores are equipped with an electric submersible pump and are used to supply water for CP's existing activities in the Mereenie Field.

The bores were purged for 35 minutes before sampling. Groundwater was collected in new laboratory supplied bottles, which were transported for analysis under standard chain of custody protocols to ALS laboratories in Brisbane. The groundwater was analysed for physical chemistry, major ions, alkalinity, nutrients, silica, dissolved and total metals, dissolved hydrocarbon gases, Polynuclear Aromatic Hydrocarbons (PAH), Total Petroleum Hydrocarbons (TPH), Total Recoverable Hydrocarbons (TRH) and BTEX.

A summary of water level, field parameters and laboratory results are presented in Appendix 4 alongside Australian drinking water guidelines (NHMRC, NRMCC 2011) and stock watering guidelines (ANZECC 2000), where applicable. All analytes are below drinking water health related guidelines and stock watering guidelines. No detections of hydrocarbon gases or products were recorded.

5.2.1.6.3 Wetlands, Springs and Groundwater Dependant Ecosystems

A search of NR Maps¹⁴ identified two springs in the general vicinity of the West Mereenie-28 well. The springs are located on the south-eastern and north-eastern margin of the Mereenie field and are positioned on drainage lines that feed into Parke Creek approximately 9 km and 13 km south-east of the West Mereenie-28 well (refer Figure 5-16).

NT Government data identifies the springs as discharge features from the Hermannsburg Sandstone, however, the surface geology and structure suggest they are more likely associated with the Parke Siltstone, as the Hermannsburg Sandstone has been eroded and is not present at their mapped locations. There are no other recorded springs or wetlands identified within 10 km of the sites.

An assessment of satellite derived datasets - The National Atlas of Groundwater Dependent Ecosystems (GDE)¹⁵ and Geoscience Australia Water Observations from Space (WOFS) - was undertaken to assess regional potential for springs and GDEs. The GDE atlas maps Parke Creek, which runs to the north-east of the Mereenie field, as having a low potential to support aquatic GDEs.

The WOFS product displays the percentage of observations in which surface water was detected and is derived from satellite imagery from 1987 to the present day (GA, 2019). The WOFS provides an indication of surface water presence, with permanence an indication of groundwater discharge. The only permanent water in the vicinity of the site is associated with water storages/dams used for the operation of the Mereenie field. All other surface water is ephemeral and is present in a low percentage of images (<20%).

Due to depth to water in the Mereenie Sandstone in the vicinity of the well sites (~50-190 mBGL), there is limited potential for surface water-groundwater interaction.

5.2.1.7 Surface Water

No ephemeral streams are located in the vicinity of the proposed West Mereenie-27 well lease. The lack of drainage patterns in the area indicates that runoff seldom, if ever, occurs. Sandy soils at the proposed area allow for surface water to infiltrate quickly, although some ponding may occur in interdunal swales where small areas of clayey soils and red earths may be present.

A series of unnamed ephemeral streams are located within 1 km of the West Mereenie well lease which eventually connects with Parke Creek (approximately 7 km from the well lease).

A map of the surface hydrology for the West Mereenie wells is provided in Figure 5-20. The buffer distance to stream orders from the disturbance areas is in line with the recommended widths specified in the DEPWS Land Clearing Guidelines (2019).

Flood modelling of the proposed West Mereenie wells has been undertaken and without mitigation both well leases are within the 1% AEP rainfall event (refer Appendix 1).

For the West Mereenie-27 well, the site is located along a ridgeline, so all overland flow paths are directed away from the site. As there is also no impact from adjacent river flows, the site is considered unaffected by flooding and no flood mitigation is required.

Some runoff from the ridge to the west of the site may affect the well infrastructure area and this will be managed through appropriate erosion and sediment control measures.

The West Mereenie-28 well lease is located at the confluence of two overland flow paths from the south and west of the well lease. During a 1% AEP rainfall event the well lease may experience up to

¹⁴ <https://nrmaps.nt.gov.au/>

¹⁵ <http://www.bom.gov.au/water/groundwater/gde/>

0.1m of inundation across most of its area. CP proposes to undertake the following works (as per the Flood Modelling Report – Refer Appendix 1) to mitigate potential flooding at this well lease:

- Install a 300 mm high diversion bund on the southern side of the well lease
- Install a 300 mm high diversion bund on the north-west corner of the well lease.

Confirmation of the extent of the bunding will be required as part of the civil design.

The civil design will incorporate the Erosion and Sediment Control Plan measures and will be implemented by the contractor during construction.



Figure 5-20: Surface hydrology (West Mereenie Wells)

- Indicative well location
- Permit
- Major Drainage
- Streams



ID: 0523-07

Rev:

Date: 20/10/2020

Map Scale is 1:191,040 when printed at A4
 Coordinate System: GCS GDA 1994

Northern Territory Mapped Streams - Department
 of Environment and Natural Resources

5.2.2 Natural Environment

5.2.2.1 Bioregions

The West Mereenie wells are located within the Great Sandy Desert bioregion – West Mereenie-27 and the MacDonnell Ranges - West Mereenie-28 (refer Figure 5-21) as classified by (Baker, et al., 2005) and described in Table 5-19 .

Table 5-19 Bioregions (West Mereenie Wells)

Bioregion ¹⁶	Topography	Geology	Soils	Vegetation
Great Sandy Desert	The area is generally flat and arid with few watercourses, although there are several low ranges	Large expanse of horizontally bedded Mereenie Sandstone and associated Cambrian marine sediments – calcareous	Predominantly shallow sands and are influenced by the presence of saline lakes, where mostly saline loams occur	Dominated by hummock grassland with areas of tall-shrubland or low open woodland, Mulga tall open-shrubland and Samphire low open-shrubland fringing salt pans
MacDonnell Ranges	High relief ranges and foothills enclose some broad plains and watercourses	Mostly sedimentary rocks in the Amadeus Basin and crystalline metamorphic rocks in the Arunta Block	Generally skeletal or shallow sands on the rocky hills with earthy sands and deep loamy alluvium on the lowlands	Dominant vegetation spinifex hummock grassland, sparse acacia shrub lands and woodlands along watercourses

5.2.2.2 Sites of Conservation Significance

There are currently 67 SOCS identified by the NT Government. SOCS are areas defined by the NT Government as important sites for biodiversity conservation that need further protecting.

The closest SOCS to the West Mereenie wells is the George Gill Range and Surrounds, located approximately 20 km to the south. Figure 5-22 provides an overview of the West Mereenie wells relative to the nearest SOCS.

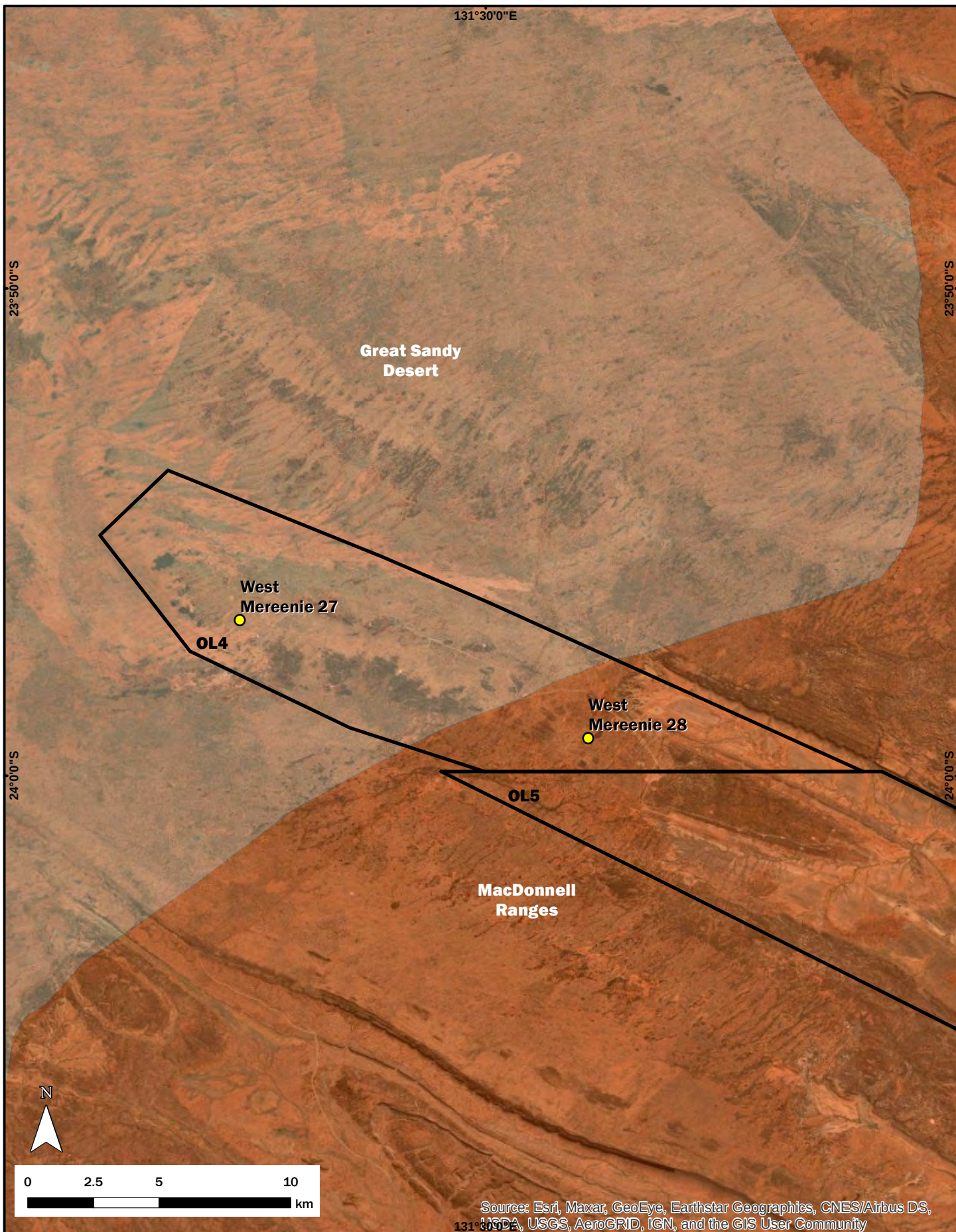
5.2.2.3 Sites of Botanical Significance

A SOBS is an area that has been defined (by White et al. 2000) to hold important and / or unique botanical assemblages that require protection. SOBS are designated as either nationally significant (41 sites), bioregionally significant (79 sites) or of undetermined significance (33 sites).

Currently there is no specific legislation attached to SOBS, although protection of the SOBS is administered through other pieces of legislation (e.g. TPWC Act etc)

The West Mereenie-27 well clearance area is located within the Laycock Sandplain SOBS whilst the West Mereenie-28 well clearance area is located within the Mereenie SOBS. Both of these SOBS are designated as bioregionally significant.

¹⁶ (Baker, et al., 2005)



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ID: 0523-02

Rev:

Date: 20/10/2020

Map Scale is 1:191,040 when printed at A4
Coordinate System: GCS GDA 1994

Interim Biogeographic Regionalisation for Australia
(IBRA) version 7.0 - Australian Government
Department of Sustainability, Environment, Water,
Population and Communities

Figure 5-21: Bioregions (West Mereenie Wells)

● Indicative well location □ Permit

IBRA region

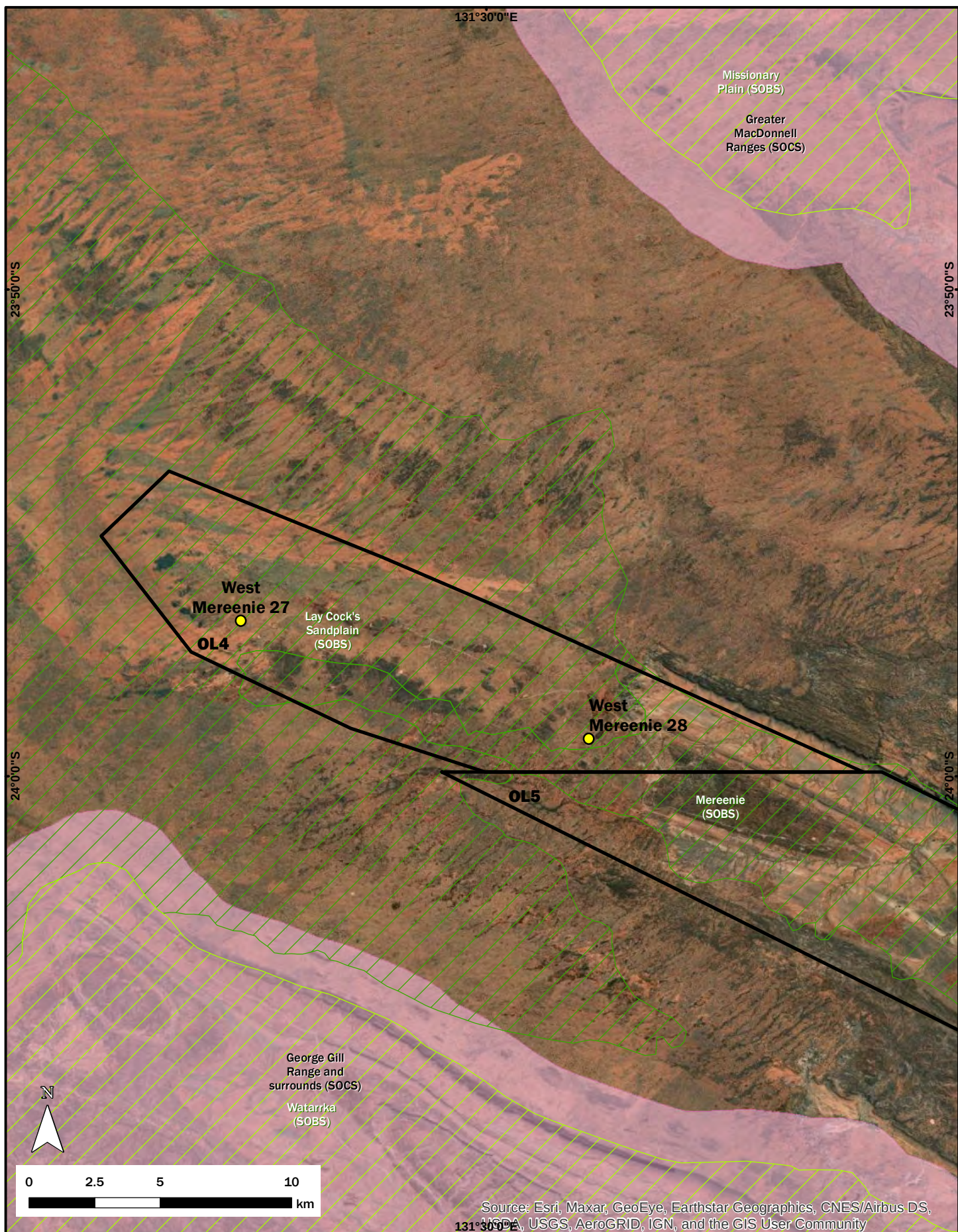
Great Sandy Desert

MacDonnell Ranges



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W centralpetroleum.com.au





ID: 0523-03

Rev: A

Date: 20/10/2020

Map Scale is 1:191,040 when printed at A4
Coordinate System: GCS GDA 1994

Sites of Conservation Significance and Sites of Botanical Significance from Department of Environment and Natural Resources - Copyright Northern Territory Government.

Figure 5-22: SOCS (West Mereenie Wells)



Indicative well location

Permit

Sites of Botanical Significance

bioregional

national

Sites of Conservation Significance

International



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Petroleum**

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5.2.2.4 Threatened Ecological Communities

No threatened ecological communities were identified within the proposed West Mereenie wells clearance area.

5.2.2.5 Conservation Significant Flora

A flora species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Flora Atlas within the sub-bioregion of the West Mereenie clearance area or
 - has been recorded during an ecological assessment of the West Mereenie clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the West Mereenie clearance area or
 - has been recorded during field surveys of the West Mereenie clearance area.

Based on the results of desktop searches, previous field survey (refer Appendix 2) and the Protected Matters Search Tool Report (refer Appendix 2) for the West Mereenie clearance area, Table 5-20 provides a summary of flora species of conservation significance which may be present within the West Mereenie clearance area and identifies the likelihood of each species occurring based on ground truthing within the West Mereenie clearance area.

During the ecological assessment, 140 flora species were recorded within the West Mereenie wells clearance areas of which:

- One introduced species (*Cenchrus ciliaris*)
- Two not evaluated under the TPWC Act (*Sida sp. Excedentifolia* - very common and widespread species formerly included within *Sida filifolia*)
- An unknown form of *Acacia aneura* (likely hybridised) was encountered in gravel plain (land type WM28-E) (latitude -23.989027; longitude 131.53134; GDA94). Seed pods and flowers are required to properly identify (which were not present) therefore a voucher specimen was not collected. This is of taxonomic interest, but is not considered as a significant species.
- Refer to Appendix 2 for the full listing of the TPWC Act Least Concern species.

No threatened species under the TPWC Act or the EPBC Act or Near Threatened species under the TPWC Act were identified during the ecological assessment.

Table 5-20 Conservation Significant Flora (West Mereenie Wells)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Ecological Survey Result	Likelihood of Occurrence ¹⁷
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	VU	VU	-	2	No	Unlikely
<i>Santalum acuminatum</i>	Desert Quandong, Native Peach	VU	-	-	7	No	Unlikely
<i>Macrozamia macdonnellii</i>	MacDonnell Ranges Cycad	NT	VU	Known to occur	0	No	Unlikely

¹⁷ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

5.2.2.6 Conservation Significant Fauna

A fauna species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Fauna Atlas within the sub-bioregion of the West Mereenie clearance area or
 - has been recorded during an ecological assessment of the West Mereenie clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the West Mereenie clearance area or
 - has been recorded during an ecological assessment of the West Mereenie clearance area.

Based on the results of desktop searches, previous ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the West Mereenie clearance area, Table 5-21 provides a summary of flora species of conservation significance which may be present within the West Mereenie clearance area and identifies the likelihood of each species occurring based on ground truthing within the West Mereenie clearance area.

Whilst no conservation significant fauna were detected during the baseline ecological assessment in December 2019 and February 2020 (MW27 new lease in October 2020), nineteen fauna species were recorded within the West Mereenie wells clearance area of which:

- One was an introduced species (horse)
- Eleven bird, six reptile and one mammal species all listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

In addition, key habitat features within the survey area were identified - namely gently sloping red sandplain, low linear dune, Mulga-dominated red earth depressions and sandy red earth areas. The survey in Appendix 2 indicates that the area is unlikely to support threatened species, including the Southern Marsupial Mole, Grey Falcon and Princess Parrot.

Table 5-21 Conservation Significant Fauna (West Mereenie Wells)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Ecological Survey Result	Likelihood of Occurrence ¹⁸
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CR	-	1	No	Unlikely
<i>Calidris tenuirostris</i>	Great Knot	VU	CR	-	1	No	Unlikely
<i>Falco hypoleucos</i>	Grey Falcon	VU	-	-	52	No	Unlikely
<i>Leipoa ocellata</i>	Malleefowl	CR	VU	-	7	No	Unlikely
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	May occur	2	No	Unlikely
<i>Polytelis alexandrae</i>	Princess Parrot	VU	VU	Likely to occur	89	No	Unlikely
<i>Liopholis kintorei</i>	Great Desert Skink	VU	VU	May occur	81	No	Unlikely

¹⁸ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Ecological Survey Result	Likelihood of Occurrence ¹⁸
<i>Liopholis slateri</i>	Slater's Skink	VU	EN	-	1	No	Unlikely
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	VU	VU	-	423	No	Unlikely
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	VU	EN	-	4	No	Unlikely
<i>Isoodon auratus</i>	Golden Bandicoot	EN	VU	-	16	No	Unlikely
<i>Lagorchestes hirsutus</i>	Mala	EW	CR	Likely to occur	12	No	Unlikely
<i>Macroderma gigas</i>	Ghost Bat	NT	VU	-	5	No	Unlikely
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	May occur	213	No	Unlikely
<i>Notoryctes typhlops</i>	Southern Marsupial Mole	VU	-	-	92	No	Unlikely
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby	NT	VU	May occur	62	No	Unlikely
<i>Rattus tunneyi</i>	Pale Field-rat	VU	-	-	1	No	Unlikely
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	VU	-		2		
<i>Trichosurus vulpecula</i>	Common Brushtail Possum (central)	EN	-	-	34	No	Unlikely
<i>Zyzomys pedunculatus</i>	Central Rock-rat	EN	CR	-	3	No	Unlikely
<i>Semotrachia euzyga</i>	a land snail	EN	EN	-	2	No	Unlikely
<i>Granulomelon squamulosum</i>	a land snail	VU	-	-	1	No	Unlikely

5.2.2.7 Weeds

Weeds managed under this EMP can be categorised via the following methods:

- WoNS – nationally agreed priority flora species for control and management. Weed species are determined based on rankings for invasiveness, potential to spread, and impact on socio-economic and environmental assets. There are currently 32 WoNS with each having an endorsed strategic plan which outlines tactics and actions for control
- Declared Weeds - species which have been identified for control, eradication, or prevention of entry in all or part of the Northern Territory under the *Weeds Management Act 2001*. Declared weeds can be of the following classes:
 - Class A – to be eradicated

- Class B – growth and spread to be controlled
- Class C – not to be introduced into the Northern Territory
- Priority / alert weeds – species which have been identified as a priority or alert weed species within the Alice Springs Regional Weed Management Plan 2013-2018.

Based on a 50 km radius from the West Mereenie wells the eight weeds identified in Table 5-22 have been recorded.

Table 5-22 Weed Records (West Mereenie Wells)

Scientific Name	Common Name	WONS	Declared	Priority / Alert
<i>Alternanthera pungens</i>	Khaki weed		✓	
<i>Argemone ochroleuca</i>	Mexican poppy		✓	
<i>Cenchrus echinatus</i>	Mossman river grass		✓	
<i>Cenchrus setaceus</i>	Fountain grass		✓	
<i>Emex australis</i>	Spiny emex		✓	
<i>Sida acuta</i>	Sida - Spiny head		✓	
<i>Sida rhombifolia</i>	Sida - Paddys lucerne		✓	
<i>Tribulus terrestris</i>	Caltrop - terrestris		✓	

A baseline weed assessment was undertaken of the West Mereenie clearance areas by a suitably qualified person in December 2019 and February 2020 (October 2020 for the new MW27 well) and no WoNS or declared weeds were observed. Buffel Grass (*Cenchrus ciliaris*), a significant threat weed, was detected at scattered locations throughout the clearance areas.

5.2.2.8 Introduced Fauna (Pests)

An introduced fauna species is considered in this EMP to be of management concern if it is:

- Listed in the Northern Territory Fauna Atlas as “Introduced” and has been recorded within a 50 km buffer of the West Mereenie wells clearance area or has been recorded on ecological surveys of the area or
- Identified as an invasive species by an EPBC Protected Matters Search Tool report within a 50 km buffer of the West Mereenie wells clearance area or has been recorded in ecological surveys of the area.

Table 5-23 provides an overview of the introduced fauna known to be within 50 km of the West Mereenie wells.

Table 5-23 Introduced Fauna (West Mereenie Wells)

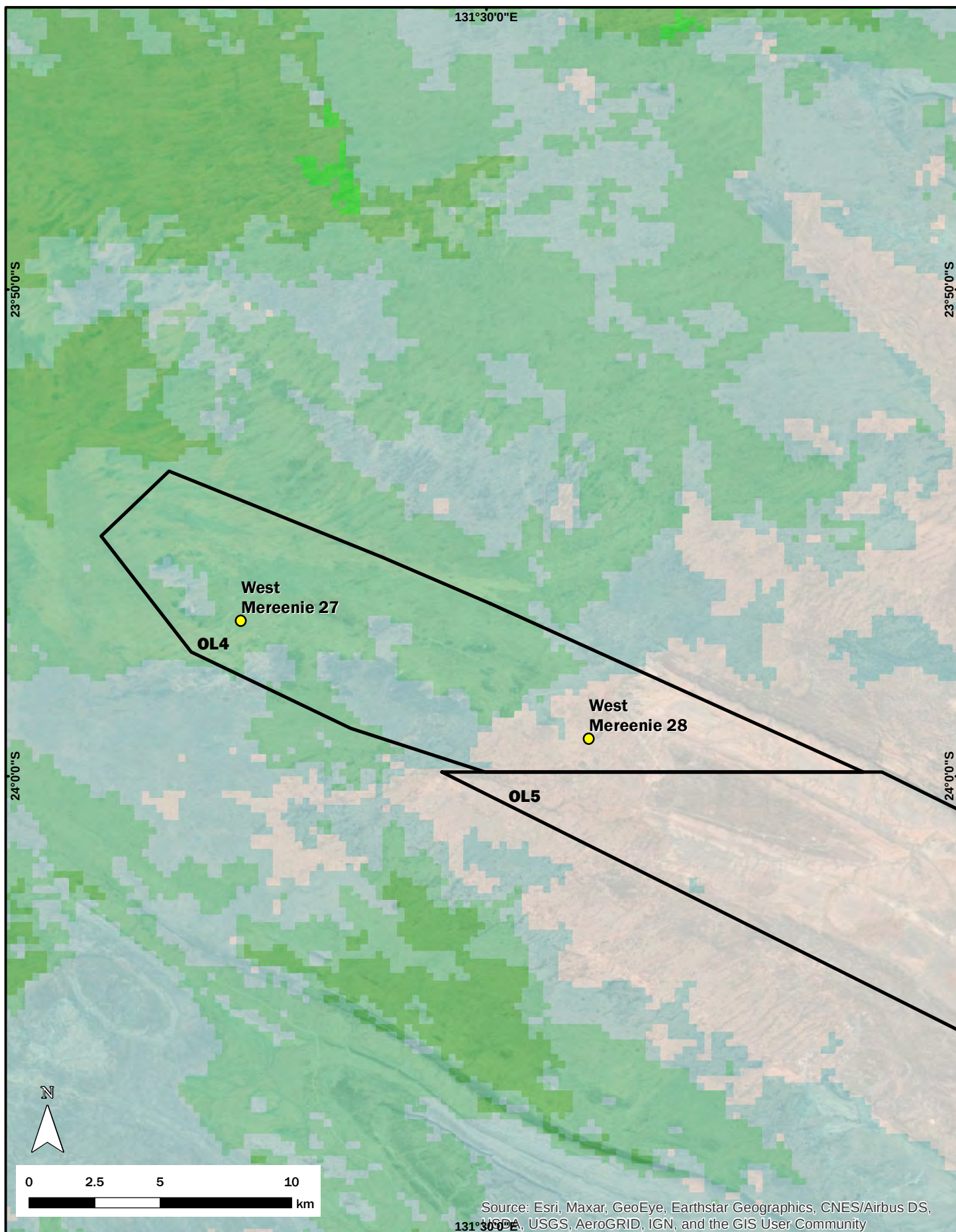
Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Reptile	Flower-pot Blind Snake	<i>Indotyphlops braminus</i>			
Mammal	Camel	<i>Camelus dromedarius</i>	✓	✓	

Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Mammal	Cat	<i>Felis catus</i>	✓		
Mammal	Cattle	<i>Bos taurus</i>	✓	✓	✓
Mammal	Donkey	<i>Equus asinus</i>	✓		
Mammal	Fox	<i>Vulpes</i>	✓	✓	
Mammal	Horse	<i>Equus caballus</i>	✓	✓	✓
Mammal	House Mouse	<i>Mus musculus</i>	✓		
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓	✓

5.2.2.9 Fire History

NAFI records show fire frequency in the West Mereenie field is low with the West Mereenie-27 well clearance area only been burnt once since the year 2000. The last fire was in 2011, which burnt the entire clearance area (part of large scale fire). The West Mereenie-28 well clearance area has had no fires since the year 2000.

Figure 5-23 Shows the fire frequency for the clearance areas and the wider West Mereenie field.



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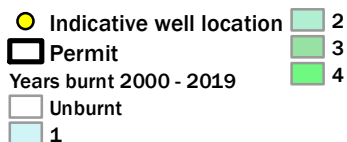
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Date: 20/10/2020

Map Scale is 1:191,040 when printed at A4
Coordinate System: GCS GDA 1994

Fire frequency - Darwin Centre for Bushfire
Research 2020

Figure 5-23: Fire Scar Mapping (West Mereenie Wells)



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5.2.3 Socio-economic Environment

An overview of the West Mereenie tenure and the locations of the West Mereenie wells in relation to populated places, roads, infrastructure and places of interests are provide in Figure 5-24.

5.2.3.1 Land Tenure

The proposed West Mereenie wells are located on Aboriginal land belonging to the Haasts Bluff Aboriginal Land Trust. CP has existing relationships with the Haasts Bluff Aboriginal Land Trust through other petroleum infrastructure located on their land.

The OL4 tenure is not located in a reserve block area or proposed reserve block location.

5.2.3.2 Surrounding Populated Places

The Mereenie field is located in one of the most remote and sparsely populated regions in Australia. The following Aboriginal communities are located within 50 km of the proposed West Mereenie wells:

- Kulpidjara
- Areyonga
- Underana
- Undandita
- Haasts Bluff
- Ipolera

Hermannsburg and Alice Springs are located approximately 110 km and 250 km east respectively of the West Mereenie wells.

5.2.3.3 Traffic

Traffic is discussed in Section 4.8.6, which indicates that traffic volumes associated with the project will be minor.

In addition, further controls are and will be in place to reduce the impact and keep other road users safe. All access tracks associated with the Mereenie Gas Field are clearly signed for authorised vehicles only. The turn in and turn offs of NT controlled roads are currently being used by CP operations and no further upgrades are required. Where vehicles associated with the Project are causing significant dust on NT controlled roads, vehicle speeds will be reduced. Oversized loads will be accompanied by an accredited Pilot.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the Mereenie wells.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the West Mereenie wells.

5.2.3.4 Workforce

Workforce numbers for each activity during the drilling campaign are discussed in Section 4.2.

- Due to the short nature of the activity, local resourcing strategy and utilisation of onsite drill rig operator camps the overall impact of the project should be positive to the local community. This assessment is based on the following:
- All contractors and employees will operate under a Pandemic (COVID-19) Management Plan which ensures there will be no direct interactions with vulnerable remote communities, pre-arrival assessment and daily monitoring of workers health, etc

- There will be no impacts on the demographics of the regional population from the drilling campaign
- CP will prioritise local resourcing, there will be contracts available and employment opportunities for a positive effect on the local business and services
- Housing and accommodation impacts will be minimised as the drill rig operator mobilises onsite camps for their own workforce. These camps are located away from communities and there will be no resulting adverse impacts.
- there will be a positive impact to lodging and services businesses in Alice Springs on crew change over days (expected 1 overnight in Alice Springs). Crew rotations will be managed to ensure that the services in Alice Springs are not overwhelmed and can continue to accommodate for tourists.
- Crews flying / driving in and out of Alice Springs will be bussed to the camp to reduce light vehicle traffic on regional roads
- CP will also explore opportunities to provide education and training opportunities to promote the gas industry, integrate the NT gas story into the tourism experience and include STEM (science, technology, engineering and mathematics) learning into local schools with technical experts and guided field trips to CP operations.

5.2.3.5 Cultural Heritage

5.2.3.5.1 Historic and Natural Heritage

The West Mereenie wells are located within the MacDonnell Shire. An online search of the Northern Territory heritage register showed 18 publicly listed heritage sites in the MacDonnell Shire, none of which are located in the within the Dingo wells clearance area. No non-public sites were found by the online search.

EPBC Protected Matters Search Tool reports for the West Mereenie wells did not identify any World Heritage Properties, National Heritage Places, Commonwealth Heritage Places or Places on the Register of National Estate within or within a 50km buffer of the West Mereenie wells (refer Appendix 2).

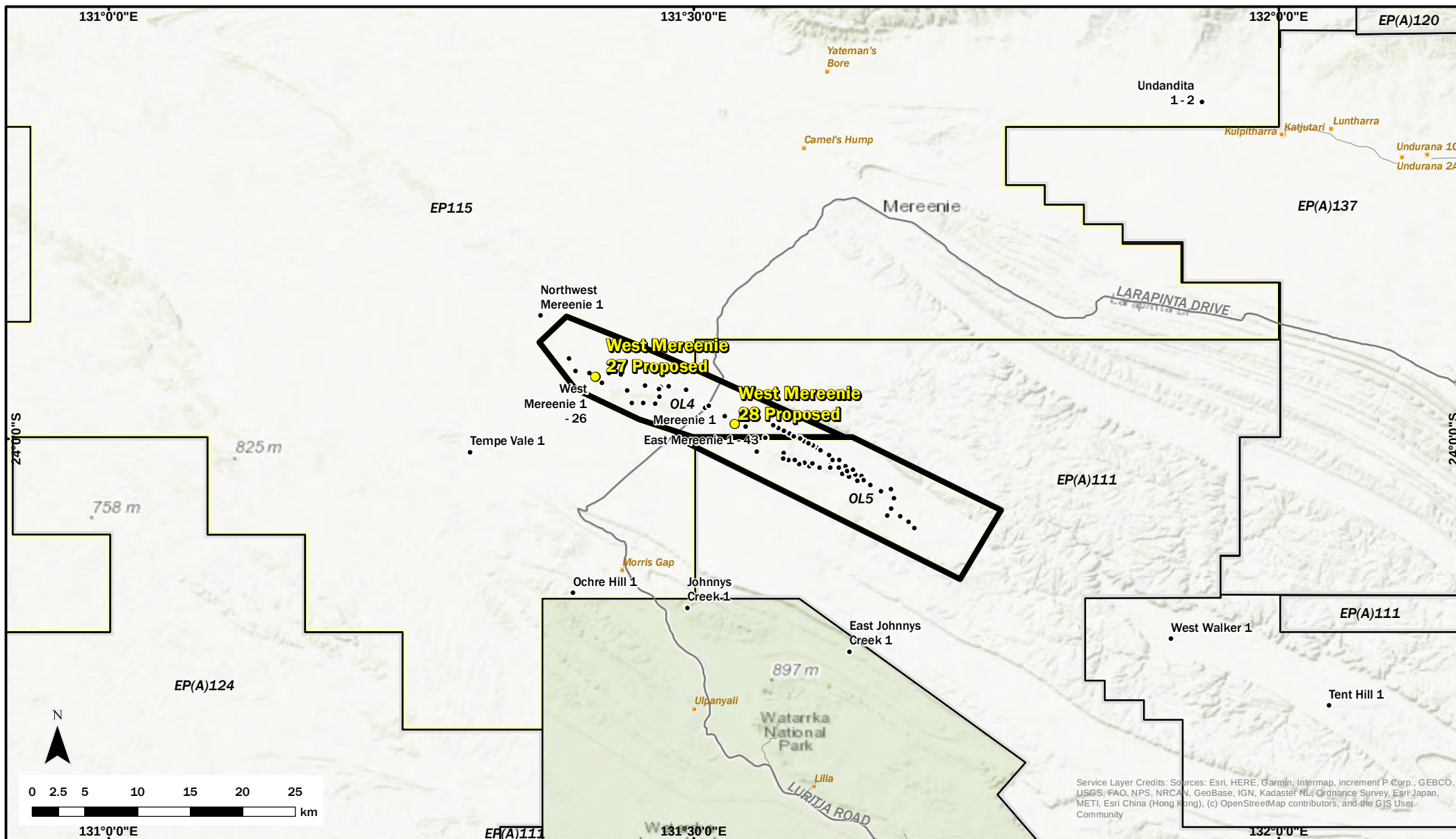
5.2.3.5.2 Aboriginal Archaeological Assessment

An Aboriginal archaeological assessment of the West Mereenie wells was undertaken by Everick Heritage in February 2020 to assess the potential impact of the drilling program on declared heritage places (i.e. all Aboriginal archaeological places) protected under the *Heritage Act 2011* (refer Appendix 3). During the assessment, one find was made in the southern part of the clearance area for the West Mereenie-28 well which requires amongst other things an exclusion area within the clearance area and further 10 m buffer from the exclusion area for any ground disturbance. CP is implementing the recommendations made in the assessment report to avoid any impacts on this find. As no impacts are anticipated, no work approval is required.

The Everick Heritage report includes an Aboriginal Objects Find / Stop Work Procedure which CP will implement at the West Mereenie wells.

5.2.3.5.3 Aboriginal Sacred Sites

In accordance with the *Aboriginal Sacred Sites Act 1989*, CP has lodged an Authority Certificate application with the AAPA for the West Mereenie wells (application # 202000411). CP commits to complying with the requirements of the granted Authority Certificate. Additionally, CP will also obtain a Sacred Site Clearance Certificate from the Central Land Council for the West Mereenie wells.



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Date: 20/10/2020

Map Scale is 1:500,000 when printed at A4
Coordinate System: GCS GDA 1994

Source:
Aboriginal Communities - Department of
Infrastructure, Planning and Logistics 2020

Figure 2-24 West Mereenie 27 & 28 locality map

● Proposed WM27 & 28	■ Aboriginal Communities	— Principal Road
■ Towns	▭ OL4 & OL5	— Secondary Road
✈ Airport	— Railway	▭ CTP Permit Application
• Petroleum Wells	— Minor Road	▭ CTP Granted Permit



5.3 Orange-3

5.3.1 Physical Environment

5.3.1.1 Climate

The Orange-3 well clearance area experiences an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable.

Climate data has been summarised using all available data from the nearest Bureau of Meteorology weather station to the well (015590, Alice Springs) and Table 5-24 shows the mean maximum and minimum temperature, mean rainfall, highest rainfall, lowest rainfall, mean days of rain and mean evaporation for each month.

Table 5-24 Climate Data (Orange-3 Well)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	36.5	35.2	32.8	28.4	23.2	19.9	19.9	22.7	27.4	31.2	33.8	35.5
Mean minimum temperature (°C)	21.6	20.8	17.6	12.6	8.2	5.0	4.0	5.9	10.3	14.8	17.9	20.3
Mean rainfall (mm)	40.6	41.2	31.0	16.5	18.5	13.0	14.9	8.6	8.7	20.0	28.2	38.1
Highest rainfall (mm)	99.6	111.8	204.8	85.6	56.6	70.6	76.8	63.0	29.0	38.8	53.2	135.8
Lowest rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean days of rain	4.8	4.5	3.2	2.1	2.9	2.7	2.5	1.8	2.3	4.4	5.4	5.9
Mean evaporation (mm)	399.9	333.2	322.4	231.0	151.9	111.0	127.1	176.7	246.0	319.3	351.0	378.2

5.3.1.2 Geology

The proposed Orange-3 well is located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the NT and into Western Australia. This basin covers an area of approximately 170,000 km² and a maximum sediment thickness of 14 000m with several major depocentres including the Idirriki, Carmichael and Ooraminna Sub-basins and Missionary Plain Trough along the northern margin and the Mount Currie and Seymour Sub-basins in the south (Geoscience Australia, 2020). It is bound in the north by the Arunta complex and in the south by the MusgraveMann complex, both containing granite, gneiss and schists, with amphibolite and quartzite.

The stratigraphy of the region is shown in Figure 5-1.

5.3.1.3 Regional Soils

Three soil types, as mapped using data from the Digital Atlas of Australian Soils (based on Northcote, et al., 1960-1968) are present within the wider Orange gas well area. Table 5-25 provides a description of these soil types with Figure 5-25 showing the location of the Orange-3 well relative to the soil types.

The Orange-3 well is located within the Ld1 soil type.

Table 5-25 Description of soils units (Orange-3 Well)

Soil Type	Landform	Soils
Mx25	Sandy plains with low sandy rises and scattered dunes. Small areas of rugged rocky hills are included locally	Alkaline and neutral red earths, with lesser areas of deep sands
AB59	Sandy plains with some dunes	Chief soils are red earthy sands and red siliceous sands on the plains
Ld1	Undulating to hilly limestone country	Chief soils are calcareous earths

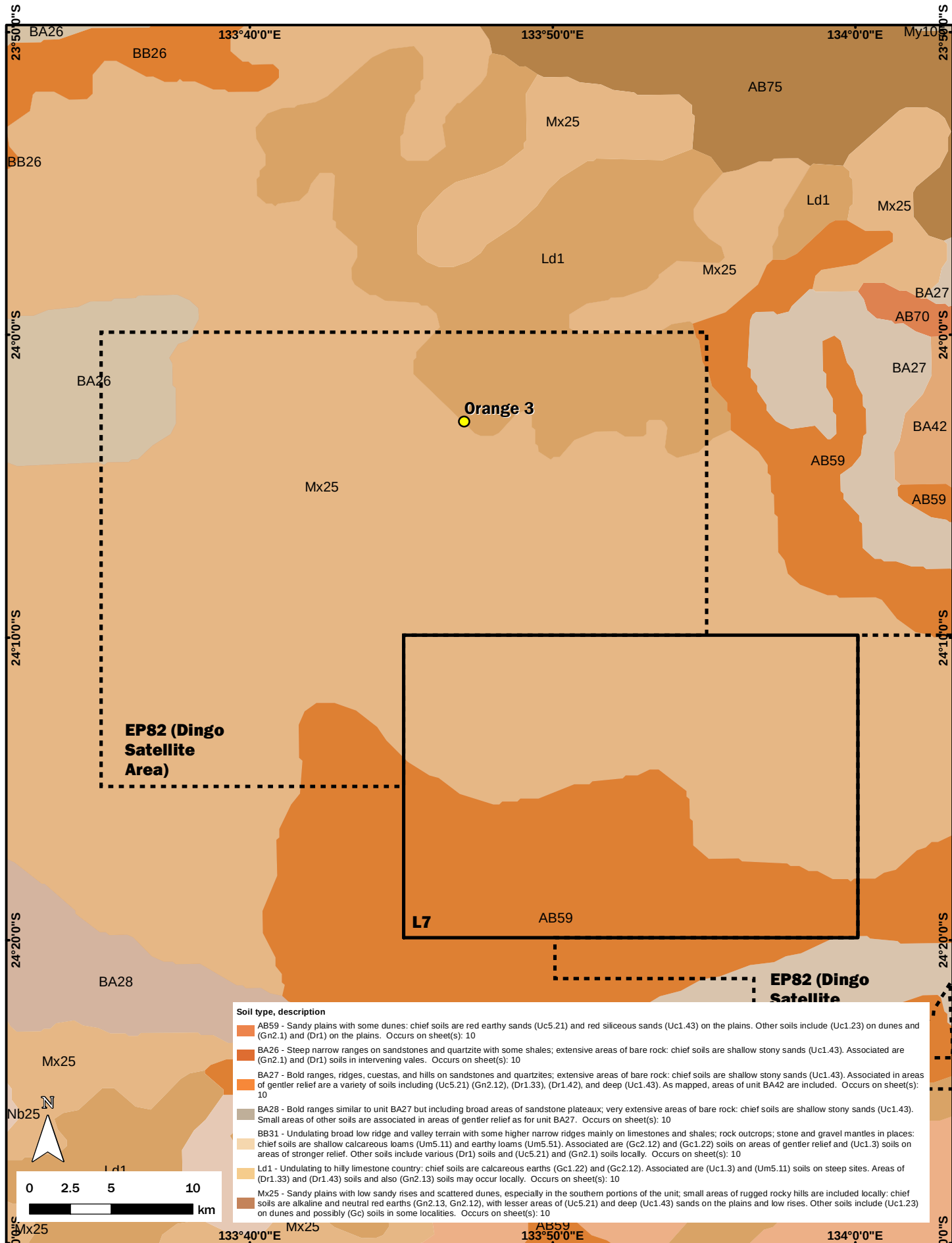


Figure 5-22: Soil Units (Orange 3 Well)

- Indicative well location
- Permit
- Permit farmout area



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Date: 1/06/2020
Map Scale is 1:304,820 when printed at A4
Coordinate System: GCS GDA 1994
Digital Atlas of Australian Soils - 1991

5.3.1.4 Land Systems

A land system is an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1968). Land system descriptions provide a general and consistent basis for determining potential habitat types present within the region of the survey areas. Land system mapping available for the Orange-3 well is at a scale of 1:1,000,000 (Perry et al. 1962).

The Orange-3 site is located within the Ewaninga land system as shown in Figure 5-26 and described in Table 5-26.

Table 5-26 Land System (Orange-3 Well)

Land System	Landform Class	Description
Ewaninga	Desert sandplains	Undulating sandy country with low sand dunes, sandplains and minor limestone hills. Quaternary aeolian sand and scattered outcrops of calcareous conglomerate and sandstone. Deep red sands and loamy limestone soils.

5.3.1.5 Land Types

Land types build upon the land systems described in Section 5.3.1.4 and are a mapping unit that delineate areas of similar landform, soils and vegetation to a reasonable level of detail and accuracy. Land types within the Orange-3 well site has been mapped at a scale of 1:5000 and is based on a survey conducted during February 2020.

Six land types were identified within the Orange-3 well clearance area as described in Table 5-27 and shown in Figure 5-27.

Table 5-27 Land Type (Orange-3 Well)

Land Type	Description	Photograph
O3-A	Gently undulating calcareous plain. Sandy loam soils. Scattered shrubs over Buffel Grass (<i>Cenchrus ciliaris</i>) and a variety of native ground cover species that are currently sparse due to dry conditions (species encountered included <i>Enneapogon avenaceus</i>, <i>Eragrostis eriopoda</i>, <i>Tribulus eichlerianus</i>, <i>Aristida arida</i> and <i>Triodia basedowii</i>). Occasional <i>Acacia aneura</i>, <i>Acacia murrayana</i> and <i>Acacia estrophiolata</i>.	

Land Type	Description	Photograph
O3-B	Slightly elevated sandy areas. Red sands; aeolian. Sparse to absent shrubs over an open spinifex (<i>Triodia basedowii</i>) grassland.	
O3-C	Low calcrete rises Shallow / skeletal calcareous sandy loam soils; exposed outcrop, mostly calcareous, but also conglomerate and other rock types present; rapid run-off. High cover of spinifex (<i>Triodia brizoides</i>) and very low cover of other flora species (including <i>Eragrostis eriopoda</i>, <i>Tribulus eichlerianus</i>, <i>Sida fibulifera</i> and <i>Sida sp. limestone</i>). Scattered <i>Senna artemisioides subsp. artemisioides</i>.	
O3-D	Minor drainage Sandy loam soils; stream channel is weakly defined and absent in some sections. An open to sparse shrubland of <i>Acacia aneura</i> over tussock grasses (unknown species due to dry conditions), including Buffel Grass.	
O3-E	Sandy hills and shortly aligned sand dunes. Red sands; aeolian. Sparse shrubs (<i>Grevillea stenobotrya</i>, <i>Acacia ligulata</i>, <i>Dodonaea viscosa subsp. mucronata</i>, <i>Acacia murrayana</i>) over spinifex (<i>Triodia basedowii</i>). Emergent and/or stunted <i>Acacia estrophiolata</i> occasionally present.	
O3-F	Clay depression. Clay soils; occurs in low points. Very sparse vegetation. Annual and short-lived flora species senesced and not present (or identifiable) at time of survey.	

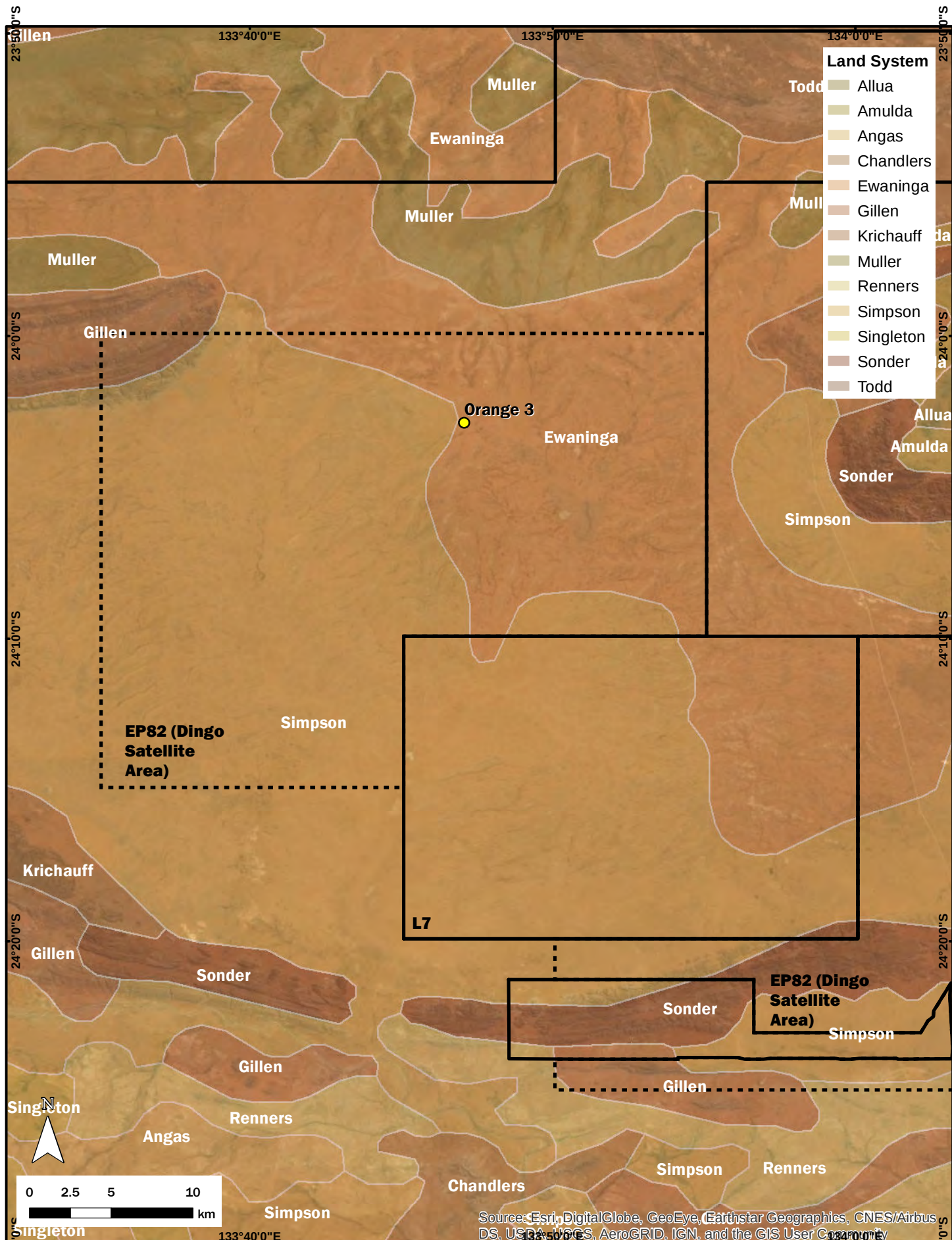


Figure 5-26: Land Systems (Orange 3 Well)

- Indicative well location
- Permit
- Permit farmout area



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Date: 1/06/2020
 Map Scale is 1:304,820 when printed at A4
 Coordinate System: GCS GDA 1994
 Land Systems - Department of Environment and Natural Resources



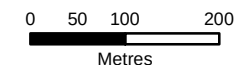
ORANGE 3

Survey data

- Orange 3 survey area (drill site)
- Orange 3 survey area (road access)
- Existing tracks or seismic lines
- Check sites
- Survey transect

Land types (1:5,000) (ground-truthed)

- O3-A: Gently undulating calcareous plain with sparse Acacia shrubs over tussock grasses (including *Cenchrus ciliaris*)
- O3-B: Slightly elevated sandy areas with sparse shrubs over spinifex (*Triodia basedowii*)
- O3-C: Low calcrete rises with spinifex (*Triodia brizoides*)
- O3-D: Minor drainages and red earth swales with patchy Mulga (*Acacia aneura*) over sparse tussock grasses
- O3-E: Sand hills / dunes with sparse shrubs (*Grevillea stenobotrya*, *Acacia ligulata*, *Dodonaea viscosa* subsp. *mucronata*, *Acacia murrayana*) over spinifex (*Triodia basedowii*)
- O3-F: Clay depressions with very sparse vegetation



MAP INFORMATION
 Scale: 1:8,000 @ A4
 Projection: GCS GDA 1994
 Date Saved: 27/04/2020
 Client: Enviro-Value
 Author / Mapper: TR

DATA SOURCE
 Survey area: Central Petroleum
 Survey data: EcOz (Feb 2020)
 Imagery: DigitalGlobe (5/11/2019)

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

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Figure 5-27 Land types within the Orange 3 clearance area

5.3.1.6 Groundwater

The Orange-3 well clearance area is located in the Amadeus Basin, an elongated east-west aligned sedimentary basin that covers an area of approximately 170 000 km² in central Australia. Lloyd and Jacobson (1987) define two main hydrogeological domains within the Amadeus Basin: the north-central area has broad folding associated with extensive and mappable sandstone formations, elsewhere in the basin greater deformation has resulted in the development of a regional fractured rock groundwater systems. Orange-3 is located in the north-central region and overlies a series of regional scale potential groundwater supply sources.

Table 5-28 provides a summary of the stratigraphy and recorded groundwater occurrence from the surface down to the Pioneer Sandstone.

Table 5-28 Summary Stratigraphy and Groundwater Occurrence (Orange-3 Well)

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Quaternary/Tertiary aged sediments	Surficial	10	Quartz sand, clay/ limestone, calcareous siltstone	Limited, potential for local useable supplies available when sufficient saturated thickness exists	Fresh to brackish	Yes
Pertnjara Formation	10	275	Sandstone, minor shale and siltstone	Poor	Brackish	No
Mereenie Sandstone	285	445	Quartz sandstone	Good potential for useable groundwater supplies across the region	Fresh	Yes
Horn Valley Siltstone	730	60	Shale, siltstone, dolomite	Poor	Not known	No
Pacoota Sandstone	790	385	Sandstone with siltstone and shale	Good potential for useable groundwater supplies across the region	Fresh	Yes
Goyder Formation	1175	145	Shale, siltstone and dolomite	Good potential for useable groundwater supplies across the region	Fresh	Yes
Shannon Formation	1320	490	Dolomite, shale	Potential for useable groundwater	Not known	Yes
Hugh River Shale	1810	170	Siltstone, shale, limestone, dolomite	Poor	Brackish	No
Giles Creek Dolomite	1980	310	Dolomite, siltstone, shale	Poor	Not known	No

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Chandler Formation	2290	210	Silty halite, minor limestone, mudstone	Poor Flows of saline water encountered during drilling of Orange 1	Saline	No
Todd River Equivalent	2500	20	Mudstone	Poor (based on thickness and lithology)	Not known	No
Arumbera Sandstone	2520	350	Interbedded sandstone, siltstone, shale	Gas Reservoir	Not known	No
Julie Formation	2870	40	Sandstone and Shale	Poor	Not known	No
Pertatataka Formation	2910	480	Siltstone and shale	Poor	Not known	No
Pioneer Sandstone	3390	-	Pebbly, feldspathic sandstone	Gas Reservoir	Not known	No

*Depths and thickness based on Orange 2 gas well

^ Water quality assessment is made for formations under the Orange exploration permit EP82 based on bore data or formation water quality from Orange 1 well completion report

The surface geology at the Orange-3 well lease comprises Quaternary and Tertiary aged sands, clay and limestone. In areas where valleys or depressions have been incised into the underlying Pertnjara Formation the Quaternary/Tertiary sediments may have sufficient saturated thickness to form local groundwater supplies. However, these groundwater sources are typically discontinuous and no bores have been successfully constructed in the Quaternary/Tertiary sequence within a 10 km radius of Orange-3 well lease.

The underlying Pertnjara Formation has limited groundwater potential – the formation is not differentiated around Orange-3, though regionally it is separated into the Brewer Conglomerate and the basal Hermannsburg Sandstone. Local water bore records suggest that most holes drilled into the Brewer Conglomerate fail to intersect groundwater or encounter limited flows of brackish water.

The Meerenie Sandstone underlies the Pertnjara Formations at depths in excess of 285 m. The Meerenie Sandstone is one of a series of regionally extensive formations that are used for groundwater supplies in the central north of the Amadeus Basin. It is of particular significance in the north of the basin where it provides the water supply for Alice Springs. In the vicinity of Orange-3 well lease the groundwater flow direction in the Meerenie Sandstone is to the south/south-east (Tickell, 2008, Macqueen and Knott, 1982). A groundwater divide was mapped roughly 10km to the north of the Dingo wells by Tickell (2008), separating the Orange well site from the Roe Creek borefield which supplies Alice Springs. More recent mapping by Cook et al. (2020) indicates that the divide has likely shifted southwards due to continued drawdown at Roe Creek and is likely that the Dingo well sites would be north the previously mapped divide, therefore groundwater in the Meerenie Sandstone at the Orange-3 site would ultimately be captured by the Roe Creek borefield. The Roe Creek borefield is more than 26 km to the north of the Orange-3 lease. Based on the potentiometric surface mapped by Cook et al. (2020), a transmissivity of 600 m²/day (Macqueen and Knott, 1982), the Meerenie

Sandstone thickness at Orange-3 (445 m - Table 5-28) and an assumed effective porosity of 10%, the average linear groundwater flow velocity is estimated to be 0.01 m/day, resulting in an estimated travel time of over 6,000 years between the well site and the borefield. Bore yields of up to 100 L/s have been recorded in the Mereenie Sandstone at Roe Creek, though this is attributed to very high secondary permeability (Macqueen and Knott, 1982) and is not representative of the formation regionally.

Bore RN011831, located 1.7 km north-west of Orange 3 is likely constructed in the Mereenie Sandstone¹⁹. The bore is constructed to a depth of 432 m with a yield of 1 L/s, groundwater depth of 108 mBGL and EC of 1,450 $\mu\text{S}/\text{cm}$. Transmissivities of up to 4,000 m²/day have been observed in the Mereenie Sandstone though 600 m²/day is considered representative for the formation at a regional scale (Macqueen and Knott, 1982).

The Pacoota Sandstone underlies the Mereenie Sandstone and extends from the northern margin of the basin near Alice Springs to the Hugh River south of Orange-3. Bore yields in the Pacoota Sandstone range from 0.1 – 80 L/s with a mean 11.4 L/s from 49 bores (Lau and Jacobson, 1991). Transmissivities range from 20 – 1,300 m²/day with a regional estimate of 600 m²/day (Macqueen and Knott, 1982). No bores are constructed in the Pacoota Sandstone in the immediate vicinity of the Orange-3, however, the well completion report for Orange-1 well records fresh water intersections in the Pacoota Sandstone. This is consistent with formation water samples from Dingo 4 located 20 km to the south-east, which reported a TDS of 500 mg/L (EC of 770 $\mu\text{S}/\text{cm}$) for the Pacoota Sandstone. In the vicinity of Orange-3 the groundwater flow direction in the Pacoota Sandstone is to the south-east.

Regionally, the Goyder Formation, Shannon Formation, Hugh River Shale and Giles Creek Formation all contain notable groundwater resources though the formations occur at significant depth beneath Orange-3 (>1,175 mBGL). To the south-west of the Orange Creek 3 well lease, these formations have loosely been grouped together as the CCA (Short, 2018). In this area the CCA has a licensed allocation of 1,170 ML/year which supports agriculture and industry. Bore yields range from 0.1 – 31 L/s with transmissivities from 4 – 580 m²/day (Jacobson and Lau, 1991). There are no bores constructed in the CCA formation in the vicinity of Orange-3. The Orange 1 well completion report notes the progressive ingress of fresh water in the Goyder Formation and groundwater intersections in fracture zones and in the base of the Shannon Formation (quality not reported). No groundwater was intersected in the Hugh River Shale and the Giles Creek Formation is described as having only trace porosity. Limited information is available on flow directions within these formations but a regional potentiometric surface for the Shannon Formation suggests the groundwater flow direction is consistent with the overlying formations and flows toward the south-east (Macqueen and Knott, 1982).

5.3.1.6.1 Groundwater Bores

A search of groundwater bores on NR Maps²⁰ identified seven registered bores within a 10 km radius of the Orange-3 well. Key details for each bore are summarised in Table 5-29

¹⁹ Bore completion records have this bore as screening the Hermannsburg Sandstone, however, correlation with the Orange1&2 well logs suggest that the Mereenie Sandstone occurs at a depth of 280 m, so it is more likely RN011831 with a completion depth of 432 m is too deep for the Hermannsburg Sandstone. Macqueen and Knott (1982) comment on the difficulty in distinguishing between these two formations from drilling chips.

²⁰ <https://nrmaps.nt.gov.au/nrmaps.html>

Table 5-29 Summary of Registered Bores within 10 km (Orange-3 Well)

Bore ID	Distance to Orange-3 (km)	Aquifer	Drilled Depth (mBGL)	Groundwater		Status	Owned by CP
				EC (μS /cm)	Depth (mBGL)		
RN010853	0.7	Mereenie Sandstone ²¹	2708.5	-	-	Orange 1 exploration well	Yes
RN011831	1.7	Mereenie Sandstone	432.9	1,450	108.4	Equipped stock bore	No
RN011533	3.1	Pertnjarra Formation	14	17,980	9.1	Abandoned mineral exploration bore, surface casing only	No
RN004966	7.6	Pertnjarra Formation	91.4	-	82	Not cased	No
RN005023	7.9	Pertnjarra Formation	24	-	-	Not cased	No
RN005024	9.5	Pertnjarra Formation	106.7	-	-	Not cased	No
RN005022	9.7	Pertnjarra Formation	9.1	-	-	Not cased	No

Bore RN011831, located 1.7 km north-west of the Orange-3 well, is the only one of the seven that was constructed. It was drilled into a sequence of brown sandstone with groundwater intersections from 306 m through to 373 m. Drilling completion records²² place the bore in the Hermannsburg Sandstone (basal unit of the Pertnjarra Formation), however, on the basis of more detailed stratigraphic interpretation from Orange 1 & 2 wells, it is more likely constructed in the Mereenie Sandstone. RN011831 is currently equipped as a stock bore.

The record for RN010853 is assigned to exploration well Orange-1. The remaining five bores were drilled through unsaturated Quaternary and Tertiary sediments into the underlying Pertnjarra Formation (locally the Brewer Conglomerate) which does not contain notable groundwater resources. All five bores were either backfilled or constructed and abandoned at time of drilling.

The bore locations, relative to Orange-3, are shown in Figure 5-28, noting that RN010853 is shown as Orange-1. Bores marked with a blue circle are recorded as “current” in NR Maps, while bores marked with a cross are designated as historical, and were either not constructed or have been abandoned. Note that although RN011533 is registered as current it was only constructed with PVC surface casing to a depth of 6 m and could not be located by CP.

Water supplies for the Orange-3 campaign will be sourced from commercial suppliers and therefore there is no potential for impacts to surrounding groundwater users.

²¹ <http://www.ntlis.nt.gov.au/hpa-services/borereport?bore=RN010853> – a file note identifies that the casing was within the Mereenie Sandstone

²² <http://www.ntlis.nt.gov.au/hpa-services/borereport?bore=RN011831>

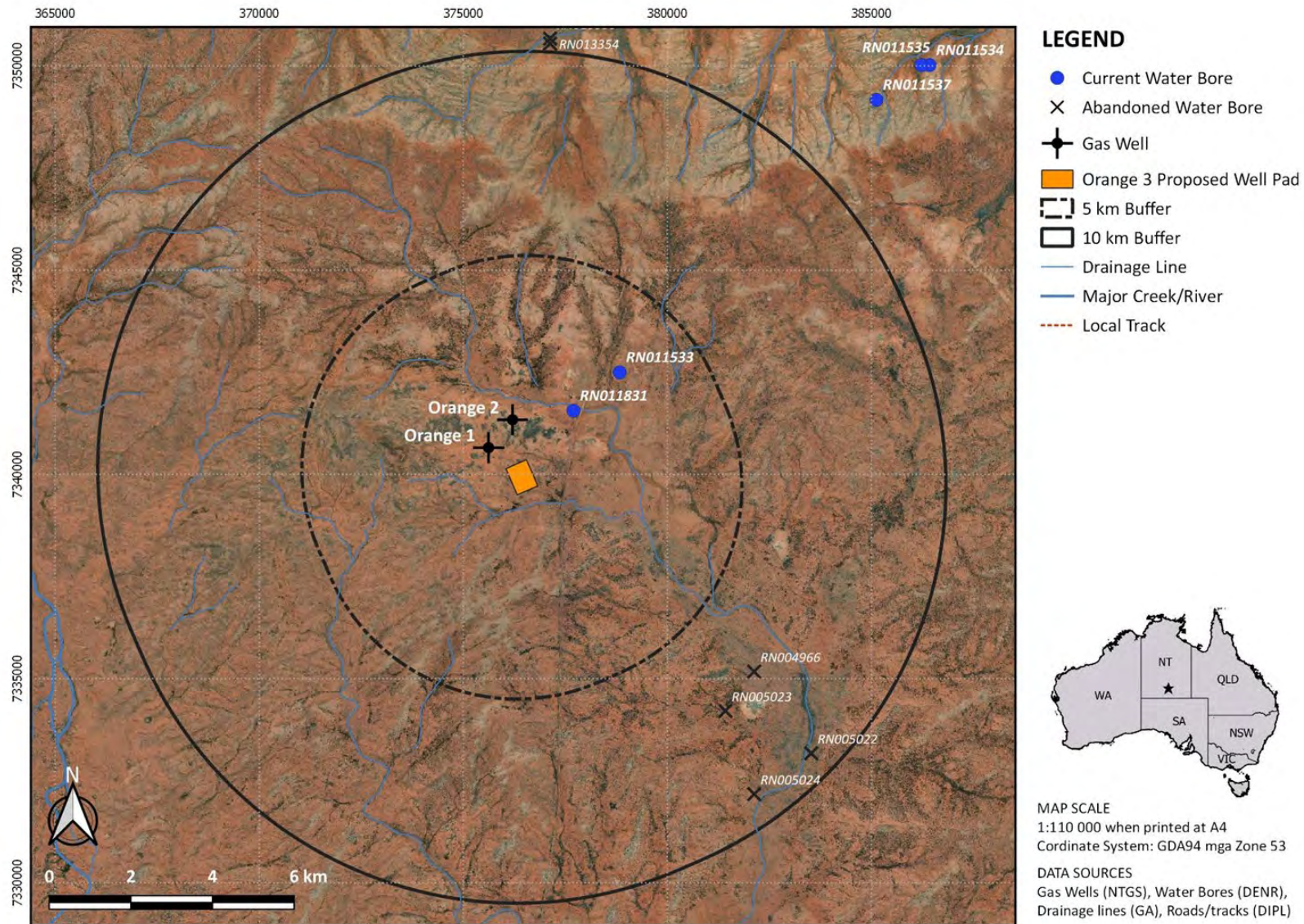


Figure 5-28 Registered Groundwater Bores within 10 Km (Orange-3 Well)

5.3.1.6.2 Baseline Groundwater Sampling and Ongoing Monitoring

A baseline groundwater sample was collected from RN011831, the closest utilised bore to the Orange-3 well on 28 February, 2020. The bore is equipped with a mono pump and is used by Owen Springs Station for stock watering.

The bore was purged for 30 minutes before sampling. Groundwater was collected in new laboratory supplied bottles, which were transported for analysis under standard chain of custody protocols to ALS laboratories in Brisbane. The groundwater was analysed for physical chemistry, major ions, alkalinity, nutrients, silica, dissolved and total metals, dissolved hydrocarbon gases, PAH, TPH, TRH and BTEX.

A summary of water level, field parameters and laboratory results are presented in Appendix 2 alongside Australian drinking water guidelines (NHMRC, NRMCC 2011) and stock watering guidelines (ANZECC 2000), where applicable. All analytes are below drinking water health related guidelines and stock watering guidelines. No detections of hydrocarbon gases or products were recorded.

Historical time series groundwater level data is not available for the aquifers in the vicinity of the Orange-3 well with the closest active monitoring bore located over 25 km to the north-east. A water level of 125.2m below top of casing was measured in RN010853 (Dingo 1) on 28 February 2020.

Despite the low potential for contamination of the Alice Springs groundwater supply (>6,000 year travel time) groundwater monitoring will be undertaken and reported in accordance with the Groundwater Monitoring Plan Dingo Gas Field and Surprise Oil Field for Operations and Maintenance Activities (CP, 2020). This includes:

- Twice yearly sampling of RN011831. Samples will be analysed by a laboratory with NATA accreditation for the required analyses (e.g. ALS laboratories), for the parameters and to the limits of detection identified B.4.17.1 Table 6 of the CoP, and
- Twice yearly measurement of water levels RN010853. This has been included as formation cross-flow will induce a pressure change that will manifest as a water level change. Pressure changes propagate much quicker than water level changes.

While these bores are not on the Orange-3 lease, they will provide an early warning of potential contamination risks to the Alice Springs groundwater supply as they are between the lease and the water supply borefield. Samples will be analysed by a laboratory with NATA accreditation for the required analyses (e.g. ALS laboratories), for the parameters and to the limits of detection identified in Groundwater Monitoring Plan Dingo Gas Field and Surprise Oil Field for Operations and Maintenance Activities (CP, 2020) (based on B.4.17.1 Table 6 of the CoP).

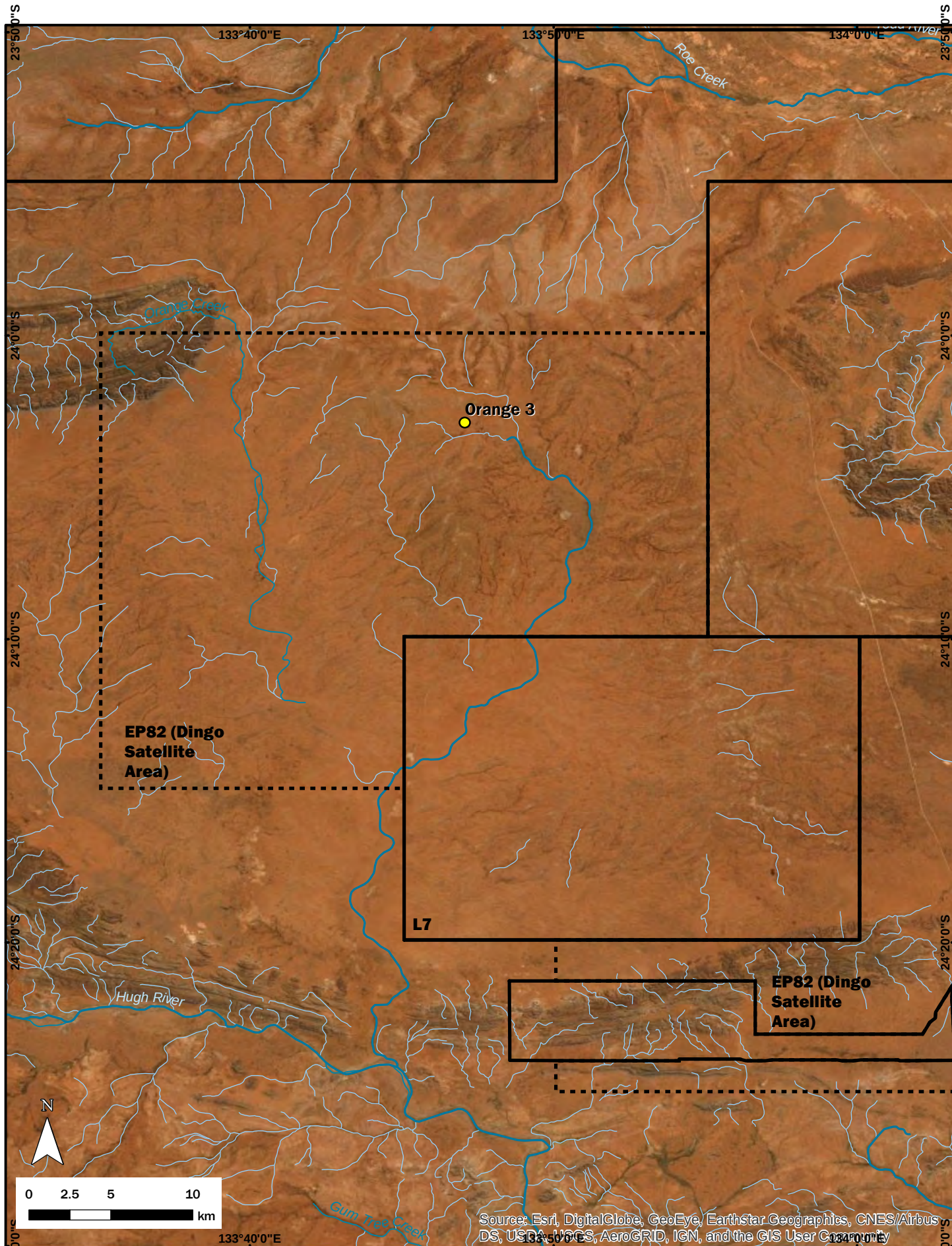
5.3.1.7 Surface Water

The Orange-3 well is situated within both the Finke River and Todd River Basins, both of which are within the Lake Eyre basin. The Lake Eyre basin covers almost one-sixth of Australia and is one of the world's largest internally draining river systems. The area supports a range of nationally important natural, social and economic values. All community sectors across the Lake Eyre Basin, scientists and governments, are involved in a collaborative effort (principally under the Lake Eyre Basin Intergovernmental Agreement) to ensure that the health of the unique river systems of the basin can be maintained (Australian Government, 2011).

A series of unnamed ephemeral streams are located within 1 km of the proposed Orange-3 well lease which eventually connects to an unnamed tributary of the Hugh River. A map of the surface hydrology for the Orange-3 well is provided in Figure 5-29. The buffer distance to stream orders from the disturbance areas is in line with the recommended widths specified in the DEPWS Land Clearing Guidelines (2019).

Flood modelling of the proposed Orange-3 well has been undertaken and without mitigation parts of the lease will experience inundation of up to 0.3 m from a 1% AEP rainfall event. CP proposes to undertake the following works (as per the Flood Modelling Report – Refer Appendix 1) to mitigate potential flooding at this well lease:

- Install a 300 mm high diversion bund along the north, east and west sides of the well lease.



Source: Esri, DigitalGlobe, GeoEye, EarthStar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 5-29 Surface hydrology (Orange 3 Well)

- Indicative well location
- Minor Drainage
- Permit
- Permit farmout area
- Streams
- Major Drainage



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Map Scale is 1:304,820 when printed at A4
Coordinate System: GCS GDA 1994

Northern Territory Mapped Streams - Department
of Environment and Natural Resources

5.3.2 Natural Environment

5.3.2.1 Bioregions

The Orange-3 well clearance area is located within the Finke bioregion (refer Figure 5-30) as classified by (Baker, et al., 2005) and described in Table 5-30 . The main land types of the Finke bioregion are arid sandplains with dissected uplands and valleys, including three major rivers; Finke, Hugh and Palmer rivers, (DoEE 2008).

Table 5-30 Bioregions (Orange-3 Well)

Bioregion	Topography	Geology	Soils	Vegetation
Finke	Geomorphologically variable complex of low sandstone ranges, weathered tablelands and rounded metamorphic hills, giving rise to undulating plains and low hills with extensive sand plains and sand dunes and flood outs	Lies over the Amadeus Basin and small parts of the Pedirka and Eromanga Basins. Contains sedimentary rocks of Devonian and Cambrian age	Soils are a mix of shallow and deep sands, massive earths, and red duplex saline affected soils.	Dominant vegetation includes hummock grasslands, <i>Acacia</i> shrublands and Saltbush / Bluebush open shrublands

5.3.2.2 Sites of Conservation Significance

There are currently 67 SOCS identified by the NT Government. SOCS are areas defined by the NT Government as important sites for biodiversity conservation that need further protecting.

The closest SOCS to the Orange-3 well clearance area is the Waterhouse Range, located approximately 20 km to the east. Figure 5-31 provides an overview of the Orange-3 well clearance area relative to the nearest SOCS.

5.3.2.3 Sites of Botanical Significance

A SOBS is an area that has been defined (by White et al. 2000) to hold important and / or unique botanical assemblages that require protection. SOBS are designated as either nationally significant (41 sites), bioregionally significant (79 sites) or of undetermined significance (33 sites).

Currently there is no specific legislation attached to SOBS, although protection of the SOBS is administered through other pieces of legislation (e.g TPWC Act etc)

The Orange-3 well clearance area is not located within a SOBS.

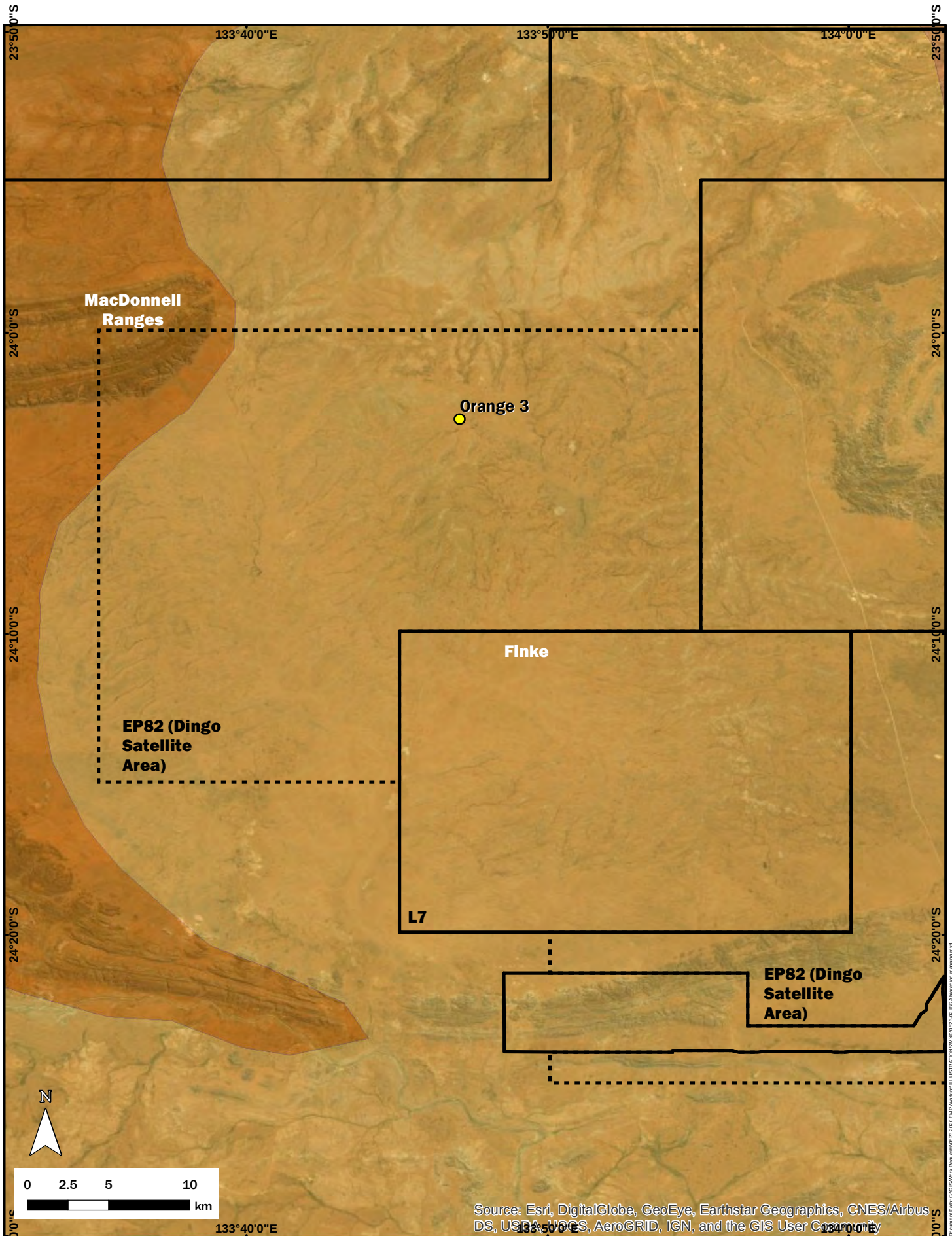
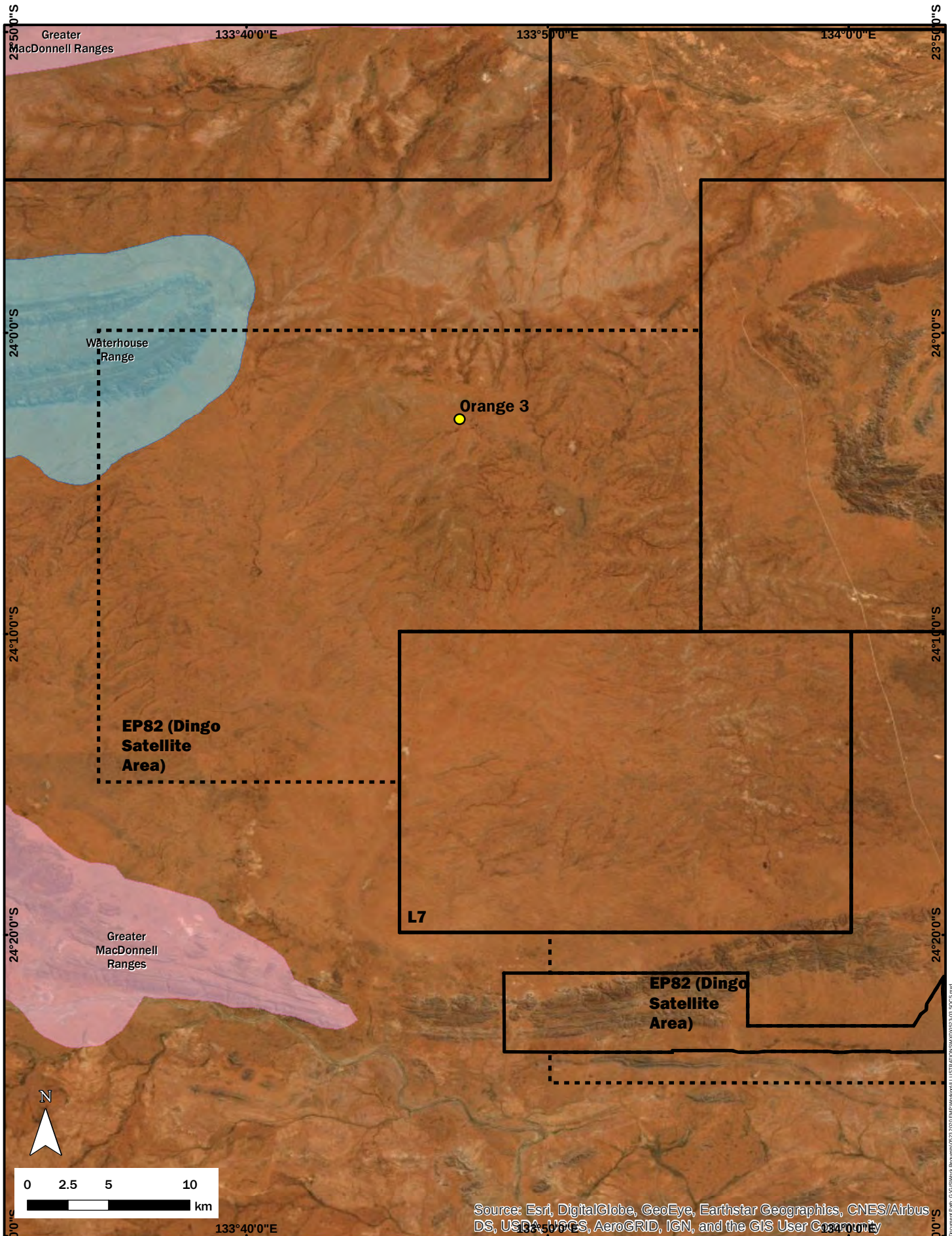


Figure 5-30 Bioregions (Orange 3 Well)

- Indicative well location
- Simpson Strzelecki Dunefields
- IBRA region
- Permit
- MacDonnell Ranges
- Permit farmout area



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Interim Biogeographic Regionalisation for Australia (IBRA) version 7.0 - Australian Government Department of Sustainability, Environment, Water, Population and Communities



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 5-31 SOCS (Orange 3 Well)

- Indicative well location
- Permit
- Permit farmout area
- International Sites of Conservation Significance
- National



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Sites of Conservation Significance from
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5.3.2.4 Threatened Ecological Communities

No threatened ecological communities were identified within the proposed Orange-3 well clearance area.

5.3.2.5 Conservation Significant Flora

A flora species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Flora Atlas within the sub-bioregion of the Orange-3 clearance area or
 - has been recorded during an ecological assessment of the Orange-3 clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Orange-3 clearance area or
 - has been recorded during field surveys of the Orange-3 clearance area.

Based on the results of desktop searches, ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Orange-3 clearance area, Table 5-31 provides a summary of flora species of conservation significance which may be present within the Orange-3 clearance area and identifies the likelihood of each species occurring based on ground truthing within the Orange-3 clearance area.

Whilst no conservation significant flora were detected during the baseline ecological assessment, twenty-nine flora species within the Orange-3 clearance area were recorded of which:

- One was an introduced species (*Cenchrus ciliaris*)
- Twenty-eight species are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

Table 5-31 Conservation Significant Flora (Orange-3 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Survey Result	Likelihood of Occurrence ²³
<i>Acacia latzii</i>	Tjilpi Wattle	VU	VU	-	4	No	Unlikely
<i>Actinotus schwarzii</i>	Desert Flannel-flower	VU	VU	Likely to occur	0	No	Unlikely
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	VU	VU	Known to occur	0	No	Unlikely
<i>Eremophila prostrata</i>	Rainbow Valley Fuchsia Bush	NT	VU	Known to occur	18	No	Unlikely
<i>Macrozamia macdonnellii</i>	MacDonnell Ranges Cycad	NT	VU	Likely to occur	0	No	Unlikely
<i>Minuria tridens</i>	Minnie Daisy	VU	VU	Known to occur	0	No	Unlikely
<i>Olearia macdonnellensis</i>	Olearia	EN	VU	Likely to occur	0	No	Unlikely
<i>Ricinocarpus gloria-medii</i>	Glory-of-the-Centre	NT	VU	Known to occur	0	No	Unlikely

²³ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Survey Result	Likelihood of Occurrence ²³
<i>Santalum acuminatum</i>	Desert Quandong, Native Peach	VU	-	-	5	No	Unlikely

5.3.2.6 Conservation Significant Fauna

A fauna species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Fauna Atlas within the sub-bioregion of the Orange-3 clearance area or
 - has been recorded during an ecological assessment of the Orange-3 clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Orange-3 clearance area or
 - has been recorded during field surveys of the Orange-3 clearance area.

Based on the results of desktop searches, ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Orange-3 clearance area, Table 5-32 provides a summary of fauna species of conservation significance which may be present within the Orange-3 clearance area and identifies the likelihood of each species occurring based on ground truthing within the Orange-3 clearance area.

Whilst no conservation significant fauna were detected during the baseline ecological assessment in February 2020, seven fauna species were recorded within the Orange-3 wells clearance area of which:

- Two were introduced species (rabbit, cattle)
- One bird (willie wagtail), three reptiles (goanna, perentine, lizards) and one mammal (dingo) species all listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

In addition, Key habitat features within the survey area were identified - namely undulating calcareous plains, calcrete rises, low sand dunes / sand hills and a minor poorly-defined drainage. The survey in Appendix 2 indicates that the area is unlikely to support threatened species, which includes the Grey Falcon.

Table 5-32 Conservation Significant Fauna (Orange-3 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Survey Result	Likelihood of Occurrence ²⁴
<i>Amytornis modesta</i>	Thick-billed Grasswren	EW	VU	May occur	0	No	Unlikely
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CR	Known to occur	4	No	Unlikely
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU	VU	May occur	0	No	Unlikely
<i>Falco hypoleucos</i>	Grey Falcon	VU	-	-	22	No	Unlikely

²⁴ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Survey Result	Likelihood of Occurrence ²⁴
<i>Limosa lapponica</i>	Bar-tailed Godwit	VU	-	May occur	6	No	Unlikely
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	May occur	0	No	Unlikely
<i>Polytelis alexandrae</i>	Princess Parrot	VU	VU	Known to occur	3	No	Unlikely
<i>Rostratula australis</i>	Australian Painted-snipe	VU	EN	May occur	1	No	Unlikely
<i>Liopholis slateri</i>	Slater's Skink	VU	EN	Known to occur	78	No	Unlikely
<i>Isodon auratus</i>	Golden Bandicoot	EN	VU	-	3	No	Unlikely
<i>Trichosurus vulpecula</i>	Common Brushtail Possum (central)	EN	-	-	1	No	Unlikely
<i>Zygomys pedunculatus</i>	Central Rock-rat	EN	CR	Known to occur	1	No	Unlikely
<i>Pseudomys australis</i>	Plains Mouse	EN	VU	-	1	No	Unlikely
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby	NT	VU	Known to occur	3	No	Unlikely
<i>Rattus tunneyi</i>	Pale Field-rat	VU	-	-	1	No	Unlikely
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	-	2	No	Unlikely
<i>Notoryctes typhlops</i>	Southern Marsupial Mole	VU	-	-	6	No	Unlikely
<i>Chlamydogobius japalpa</i>	Finke Goby	VU	-	-	5	No	Unlikely
<i>Semotrachia euzyga</i>	a land snail	EN	EN	Likely to occur	1	No	Unlikely
<i>Sinumelon bednalli</i>	Bednall's Land Snail	NT	CR	Likely to occur	6	No	Unlikely

5.3.2.7 Weeds

Weeds managed under this EMP can be categorised via the following methods:

- WoNS – nationally agreed priority flora species for control and management. Weed species are determined based on rankings for invasiveness, potential to spread, and impact on socio-economic and environmental assets. There are currently 32 WoNS with each having an endorsed strategic plan which outlines tactics and actions for control

- Declared Weeds - species which have been identified for control, eradication, or prevention of entry in all or part of the Northern Territory under the *Weeds Management Act 2001*. Declared weeds can be of the following classes:
 - Class A – to be eradicated
 - Class B – growth and spread to be controlled
 - Class C – not to be introduced into the Northern Territory
- Priority / alert weeds – species which have been identified as a priority or alert weed species within the Alice Springs Regional Weed Management Plan 2013-2018.

Based on a 50 km radius from the Orange-3 clearance area the twenty-nine weed species identified in Table 5-33 have been recorded in the Northern Territory Atlas.

Table 5-33 Weed Records (Orange-3 Well)

Scientific Name	Common Name	WONS	Declared	Priority / Alert
<i>Andropogon gayanus</i>	Gamba grass	✓	✓	
<i>Calotropis procera</i>	Rubber bush		✓	✓
<i>Carthamus lanatus</i>	Saffron thistle		✓	
<i>Cenchrus echinatus</i>	Mossman river grass		✓	
<i>Cenchrus setaceus</i>	Fountain grass		✓	
<i>Cylindropuntia fulgida</i>	Rope cactus - fulgida	✓	✓	✓
<i>Cylindropuntia imbricata</i>	Rope cactus - Devils rope	✓	✓	✓
<i>Datura ferox</i>	Thornapple - Longspine		✓	
<i>Datura inoxia</i>	Thornapple - inoxia		✓	
<i>Datura wrightii</i>	Thornapple - wrightii		✓	
<i>Echium plantagineum</i>	Patterson's curse		✓	
<i>Emex australis</i>	Spiny emex		✓	
<i>Jatropha gossypifolia</i>	Bellyache bush		✓	
<i>Lantana camara</i>	Lantana - common		✓	
<i>Lycium ferocissimum</i>	African boxthorn		✓	
<i>Opuntia elatior</i>	Prickly pears - elatior	✓	✓	
<i>Opuntia stricta</i>	Prickly pears - stricta	✓	✓	
<i>Parkinsonia aculeata</i>	Parkinsonia	✓	✓	✓
<i>Prosopis pallida</i>	Mesquite	✓	✓	
<i>Prosopis velutina</i>	Mesquite - velutina	✓	✓	
<i>Ricinus communis</i>	Castor oil plant		✓	
<i>Senna obtusifolia</i>	Senna - Sicklepod		✓	
<i>Senna occidentalis</i>	Senna - Coffee		✓	
<i>Sida acuta</i>	Sida - Spiny head		✓	
<i>Sida rhombifolia</i>	Sida - Paddys lucerne		✓	

Scientific Name	Common Name	WONS	Declared	Priority / Alert
<i>Tamarix aphylla</i>	Athel pine	✓	✓	✓
<i>Tribulus terrestris</i>	Caltrop - terrestris		✓	
<i>Xanthium spinosum</i>	Burr - Bathurst		✓	
<i>Xanthium strumarium</i>	Burr - Noogoora		✓	

A baseline weed assessment was undertaken of the Orange-3 clearance area by a suitably qualified person in February 2020 and no WoNS or declared weeds were observed. Buffel Grass (*Cenchrus ciliaris*), a priority weed, was detected within the calcareous plains (land type O3-A).

5.3.2.8 Introduced Fauna (Pests)

An introduced fauna species is considered in this EMP to be of management concern if it is:

- Listed in the Northern Territory Fauna Atlas as “Introduced” and has been recorded within a 50 km buffer of the Orange-3 well clearance area or has been recorded on ecological surveys of the area or
- Identified as an invasive species by an EPBC PMST report within a 50 km buffer of the Orange-3 well clearance area or has been recorded in ecological surveys of the area.

Table 5-34 provides an overview of the introduced fauna within 50 km of the Orange-3 well clearance area.

Table 5-34 Introduced Fauna (Orange-3 Well)

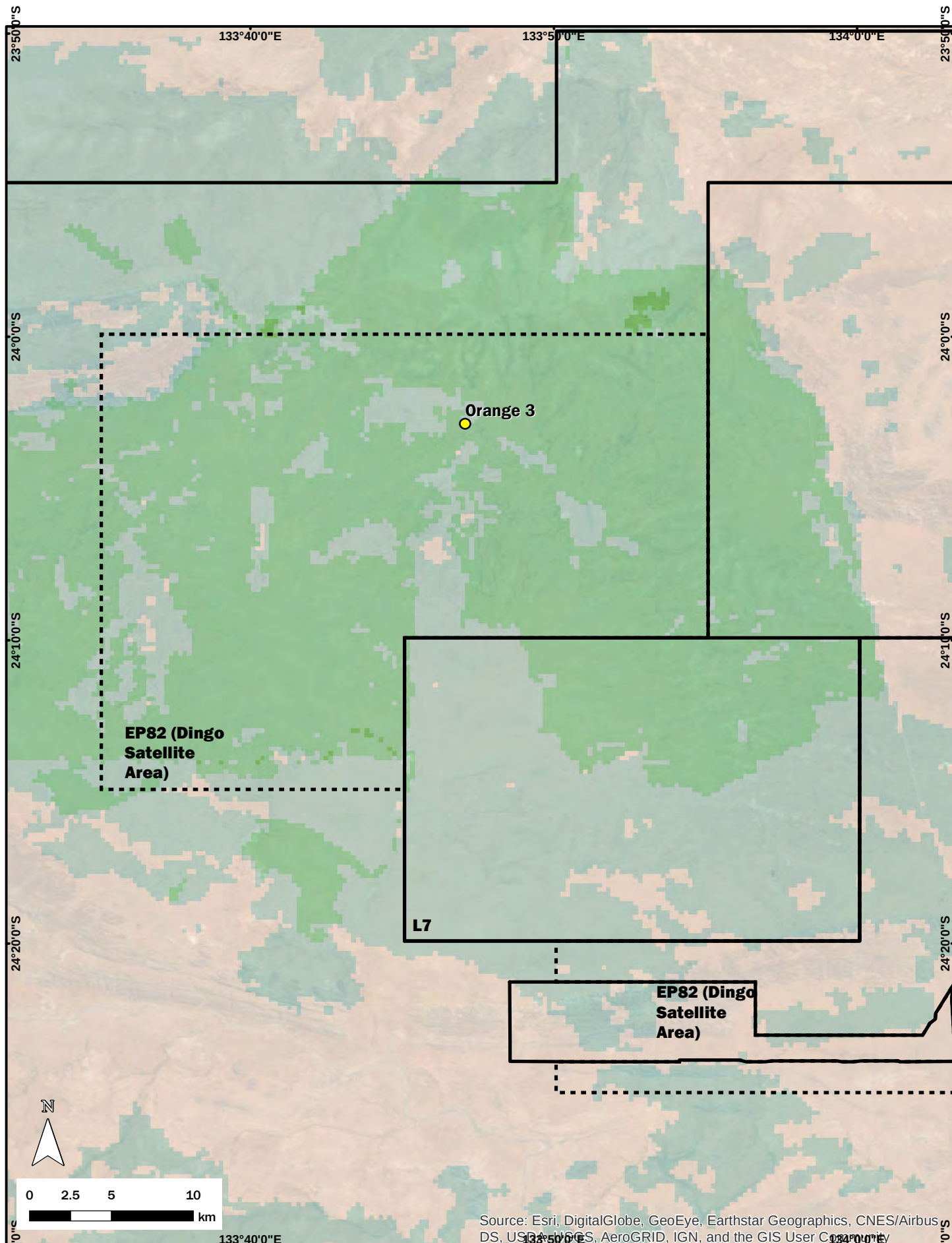
Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Reptile	Flower-pot Blind Snake	<i>Indotyphlops braminus</i>	✓		
Bird	Barbary Dove	<i>Streptopelia roseogrisea</i>	✓		
Bird	Common Starling	<i>Sturnus vulgaris</i>	✓		
Bird	House Sparrow	<i>Passer domesticus</i>	✓		
Bird	Long-billed Corella	<i>Cacatua tenuirostris</i>	✓		
Bird	Rock Dove	<i>Columba livia</i>	✓		
Bird	Spotted Turtle-dove	<i>Spilopelia chinensis</i>	✓		
Mammal	Black Rat	<i>Rattus</i>	✓		
Mammal	Brown Rat	<i>Rattus norvegicus</i>	✓		
Mammal	Camel	<i>Camelus dromedarius</i>	✓	✓	
Mammal	Cat	<i>Felis catus</i>	✓		
Mammal	Cattle	<i>Bos taurus</i>	✓	✓	✓
Mammal	Fox	<i>Vulpes</i>	✓	✓	
Mammal	Horse	<i>Equus caballus</i>	✓	✓	
Mammal	House Mouse	<i>Mus musculus</i>	✓		
Mammal	Pig	<i>Sus scrofa</i>	✓		
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓	✓

Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Fish	Eastern Gambusia	<i>Gambusia holbrooki</i>	✓		
Fish	Swordtail	<i>Xiphophorus hellerii</i>	✓		

5.3.2.9 Fire History

NAFI records show that fire frequency in the wider Orange gas well area as low with only one fire occurring since the year 2000. This fire occurred in 2011, which burnt the western half of the clearance area and was part of a large-scale fire in the area.

Figure 5-32 shows the fire frequency for the clearance area and the wider Orange well development area.



Doc Ref: 0523-11

Date: 1/06/2020

Map Scale is 1:304,820 when printed at A4
Coordinate System: GCS GDA 1994

Fire frequency - Darwin Centre for Bushfire
Research 2020

Figure 5-32 Fire Scar Mapping (Orange 3 Well)

- Indicative well location
- Permit
- Permit farmout area
- Years burnt 2000 - 2019
- Unburnt

- 1
- 2
- 3



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5.3.3 Socio-economic Environment

An overview of the Orange tenure and the locations of the Orange-3 well in relation to populated places, roads, infrastructure and places of interests are provide in Figure 5-33.

5.3.3.1 Land Tenure

The proposed Orange-3 well will be located within a single property, which details are provided in Table 5-35 . CP has existing relationships with the leaseholder through other petroleum infrastructure located on their property.

Table 5-35 Underlying Land Tenure (Orange-3 Well)

Property Name	Survey Plan Number	Land Tenure	Landholder	Primary Use
Owen Springs	S821025	Pastoral Lease	Northern Territory Government	Pastoral Lease and Nature Reserve

The EP82 tenure does not have any petroleum reserve blocks. There is a proposed petroleum reserve block on the North East corner of the tenure. This proposed petroleum reserve block has no impact on the proposed Orange-3 proposed well location.

5.3.3.2 Surrounding Populated Places

Populated places close to the Orange-3 wells are:

- Alice Springs, approximately 40 km to the north
- Santa Teresa, approximately 60 km to the southeast
- Titjikala (Maryvale), approximately 80 km to the south
- Hermannsburg, approximately 100 km to the west.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the Orange-3 well.

5.3.3.3 Traffic

Traffic is discussed in Section 4.8.6, which indicates that traffic volumes associated with the project will be minor.

In addition, further controls are and will be in place to reduce the impact and keep other road users safe. All access tracks associated with the EP 82 tenure are clearly signed for authorised vehicles only. The turn in and turn offs of NT controlled roads are currently being used by CP operations and no further upgrades are required. Where vehicles associated with the Project are causing significant dust on NT controlled roads, vehicle speeds will be reduced. Oversized loads will be accompanied by an accredited Pilot.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities from the Orange well.

5.3.3.4 Workforce

Workforce numbers for each activity during the drilling campaign are discussed in Section 4.2.

- Due to the short nature of the activity, local resourcing strategy and utilisation of onsite drill rig operator camps the overall impact of the project should be positive to the local community. This assessment is based on the following:
- All contractors and employees will operate under a Pandemic (COVID-19) Management Plan which ensures there will be no direct interactions with vulnerable remote communities, pre-arrival assessment and daily monitoring of workers health, etc
- There will be no impacts on the demographics of the regional population from the drilling campaign
- CP will prioritise local resourcing, there will be contracts available and employment opportunities for a positive effect on the local business and services
- Housing and accommodation impacts will be minimised as the drill rig operator mobilises onsite camps for their own workforce. These camps are located away from communities and there will be no resulting adverse impacts.
- there will be a positive impact to lodging and services businesses in Alice Springs on crew change over days (expected 1 overnight in Alice Springs). Crew rotations will be managed to ensure that the services in Alice Springs are not overwhelmed and can continue to accommodate for tourists.
- Crews flying / driving in and out of Alice Springs will be bussed to the camp to reduce light vehicle traffic on regional roads
- CP will also explore opportunities to provide education and training opportunities to promote the gas industry, integrate the NT gas story into the tourism experience and include STEM (science, technology, engineering and mathematics) learning into local schools with technical experts and guided field trips to CP operations.

5.3.3.5 Cultural Heritage

5.3.3.5.1 Historic and Natural Heritage

The Orange-3 well is located within the MacDonnell Shire. An online search of the Northern Territory heritage register showed 18 publicly listed heritage sites in the MacDonnell Shire, none of which are located within the Orange-3 well clearance area. No non-public sites were found by the online search.

EPBC Protected Matters Search Tool reports for the Orange-3 wells did not identify any World Heritage Properties, National Heritage Places, Commonwealth Heritage Places or Places on the Register of National Estate within or within a 50km buffer of the Orange-3 wells (refer Appendix 2).

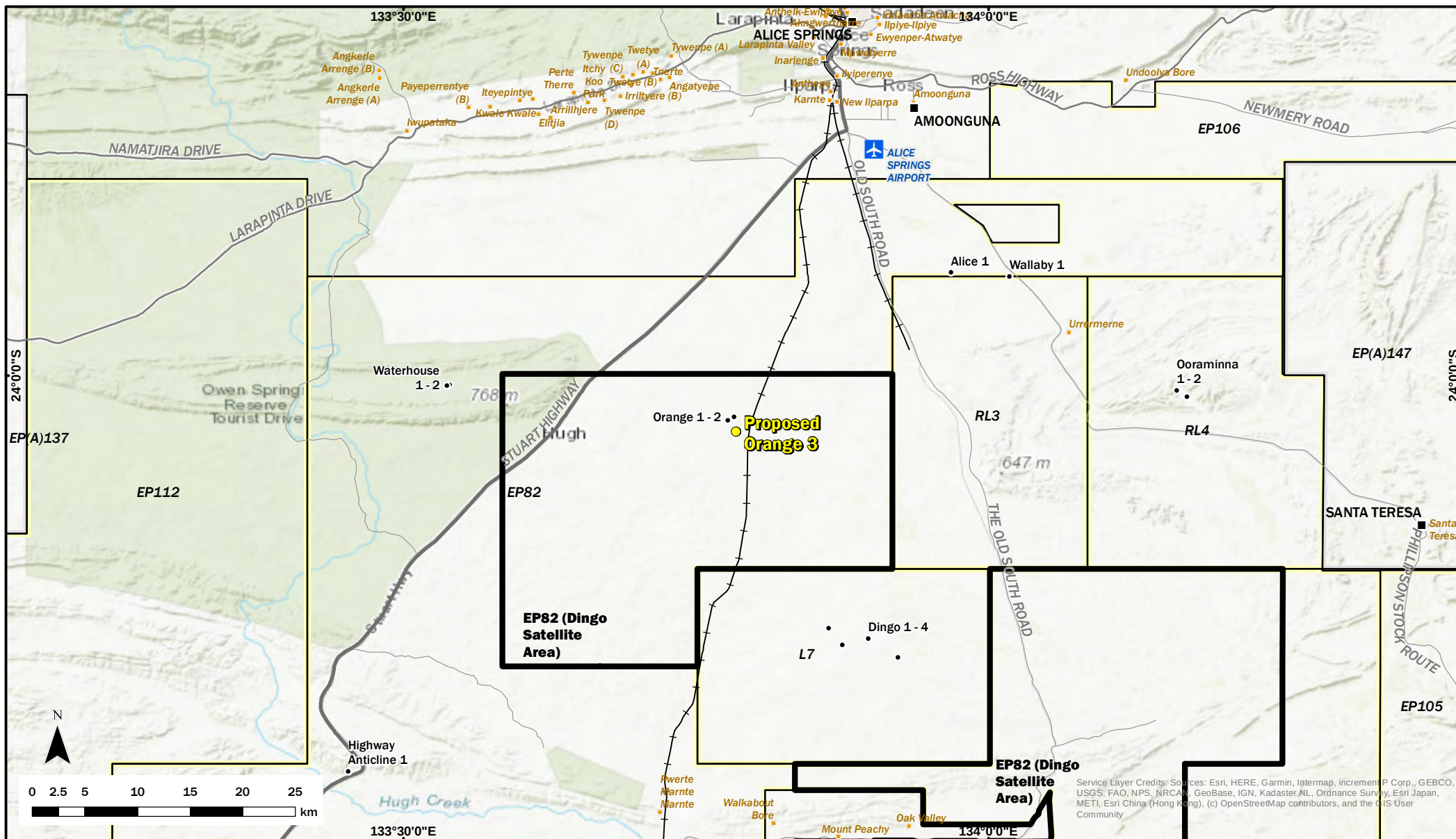
5.3.3.5.2 Aboriginal Archaeological Assessment

An Aboriginal archaeological assessment of the Orange-3 clearance area was undertaken by Everick Heritage in February 2020 to assess the potential impact of the drilling program on declared heritage places (i.e. all Aboriginal archaeological places) protected under the *Heritage Act 2011* (refer Appendix 3). During the assessment, two finds were made to the north of the clearance area which requires amongst other things an exclusion area within the clearance area and further 10 m buffer from the exclusion area for any ground disturbance. CP is implementing the recommendations made in the assessment report. As no impacts are anticipated, a works approval is not required.

The Everick Heritage report includes an Aboriginal Objects Find / Stop Work Procedure which CP will implement at the Orange-3 well.

5.3.3.5.3 Aboriginal Sacred Sites

In accordance with the *Aboriginal Sacred Sites Act 1989*, CP has received an Authority Certificate from AAPA for the Orange-3 well (Certificate # 2020/033). CP commits to complying with the requirements of the granted Authority Certificate. Additionally, CP will also obtain a Sacred Site Clearance Certificate from the Central Land Council for the Orange-3 well.



ID: 0513-021-MAP
 Rev: C
 Date: 18/08/2020
 Map Scale is 1:500,000 when printed at A4
 Coordinate System: GCS GDA 1994
 Source:
 Aboriginal Communities - Department of
 Infrastructure, Planning and Logistics 2020

Figure 5-33 Orange 3 locality map

● Proposed Orange 3	■ Aboriginal Communities	— Principal Road
■ Towns	▭ EP82 (Dingo Satellite Area)	— Secondary Road
✈ Airport	— Railway	▭ CTP Permit Application
• Petroleum Wells	— Minor Road	▭ CTP Granted Permit

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5.4 Palm Valley-12

5.4.1 Physical Environment

5.4.1.1 Climate

The Palm Valley-12 well location experiences an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable.

Climate data has been summarised using all available data from the nearest Bureau of Meteorology weather station to the well (015633, Palm Valley) and Table 5-36 shows the mean maximum and minimum temperature, mean rainfall, highest rainfall, lowest rainfall, mean days of rain and mean evaporation for each month.

Table 5-36 Climate Data (Palm Valley-12 Well)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	38.8	40.1	36.8	30.7	26.6	21.5	21.8	25.6	30.5	34.3	36.9	40.0
Mean minimum temperature (°C)	19.0	21.6	17.8	11.4	7.2	3.8	2.4	4.7	9.6	12.0	17.2	21.0
Mean rainfall (mm)	35.1	45.4	38.2	22.9	20.5	12.6	14.2	5.2	9.2	18.3	38.8	43.3
Highest rainfall (mm)	184.4	471.8	211.1	341.4	131.1	56.4	109.2	37.6	101.1	87.1	193.2	212.8
Lowest rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean days of rain	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mean evaporation (mm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

5.4.1.2 Geology

The proposed Palm Valley-12 well is located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the NT and into Western Australia. This basin covers an area of approximately 170,000 km² and a maximum sediment thickness of 14 000m with several major depocentres including the Idirriki, Carmichael and Ooraminna Sub-basins and Missionary Plain Trough along the northern margin and the Mount Currie and Seymour Sub-basins in the south (Geoscience Australia, 2020). It is bound in the north by the Arunta complex and in the south by the MusgraveMann complex, both containing granite, gneiss and schists, with amphibolite and quartzite.

The stratigraphy of the region is shown in Figure 5-1.

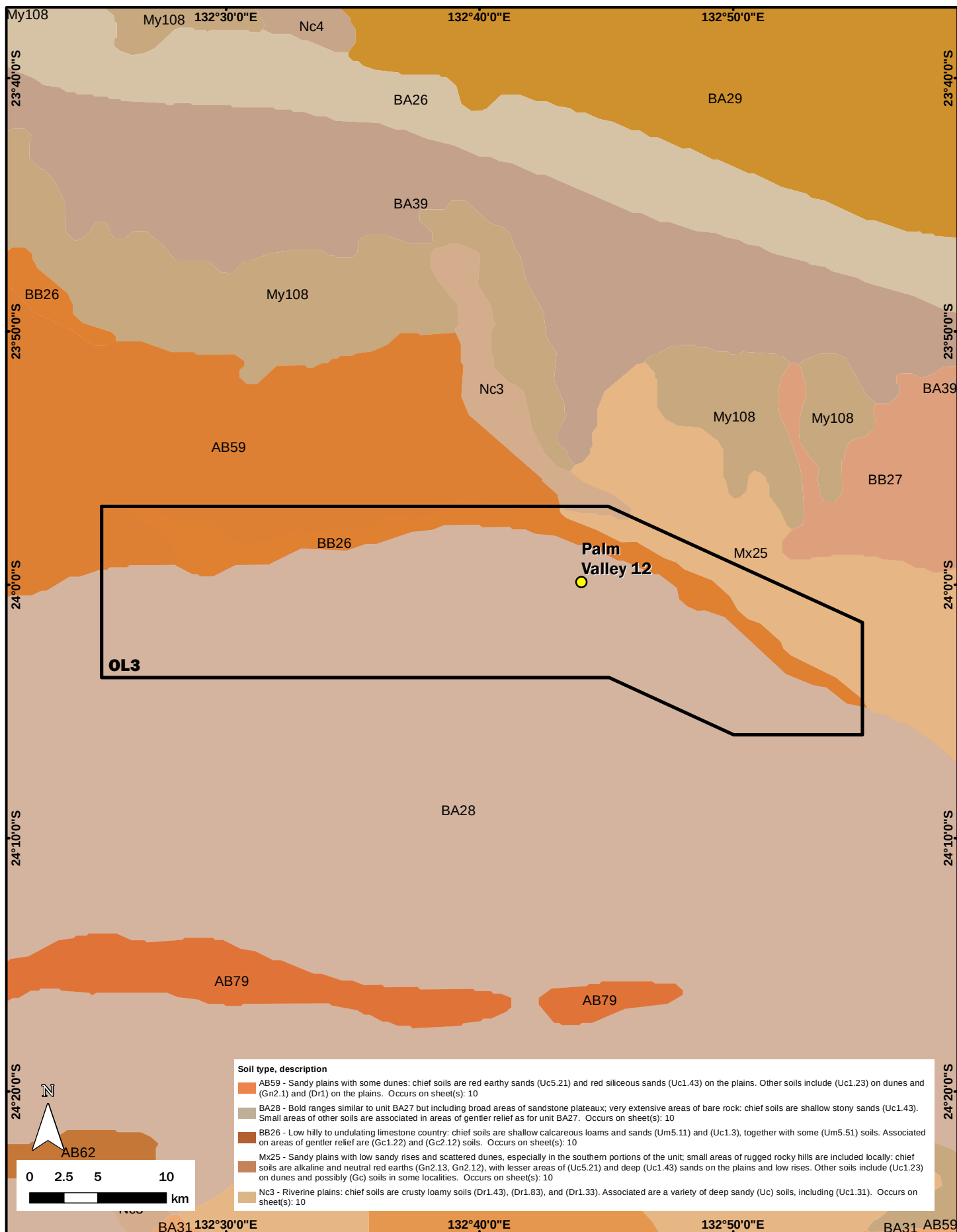
5.4.1.3 Regional Soils

Four soil types, as mapped using data from the Digital Atlas of Australian Soils (based on Northcote, et al., 1960-1968) are present within the wider Palm Valley field. Table 5-37 provides a description of these soil types with Figure 5-34 showing the location of the Palm Valley-12 well relative to the soil types.

The Palm Valley-12 well is located within the BA28 soil type.

Table 5-37 Description of soils units (Palm Valley-12 Well)

Soil Type	Landform	Soils
Mx25	Sandy plains with low sandy rises and scattered dunes. Small areas of rugged rocky hills are included locally	Alkaline and neutral red earths, with lesser areas of deep sands
BA28	Bold ranges, ridges, cuestas, and hills on sandstones and quartzites. Extensive areas of bare rock	Chief soils are shallow stony sands
BB26	Low hilly to undulating limestone country	chief soils are shallow calcareous loams and sands
Nc3	Riverine plains	Chief soils are crusty loamy soils, with lesser areas of deep sandy soils



ID: 0523-06
 Rev:
 Date: 1/06/2020
 Map Scale is 1:366,170 when printed at A4
 Coordinate System: GCS GDA 1994
 Digital Atlas of Australian Soils - 1991

Figure 5-34 Soil Units (Palm Valley 12 Well)

- Indicative well location
- Permit



5.4.1.4 Land Systems

A land system is an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1968). Land system descriptions provide a general and consistent basis for determining potential habitat types present within the region of the survey areas. Land system mapping available for the Palm Valley-12 well is at a scale of 1:1,000,000 (Perry et al. 1962).

The Palm Valley-12 well is located within the Krichauff land system as shown in Figure 5-47 and described in Table 5-38.

Table 5-38 Land System (Palm Valley-12 Well)

Land System	Landform Class	Description
Krichauff	Sandstone hills	Bold sandstone plateaux. Stony plateaux, tablelands & hills on sandstone, siltstone, quartzite & conglomerate (deeply weathered in places). Strongly superimposed drainages with narrow gorges and joint-controlled tributaries that can feed into riverine channels. Relief up to 200m. Outcrop with shallow stony soils.

5.4.1.5 Land Types

Land types build upon the land systems described in Section 5.3.1.4 and are a mapping unit that delineate areas of similar landform, soils and vegetation to a reasonable level of detail and accuracy. Land types within the Palm Valley-12 well location has been mapped at a scale of 1:5000 and is based on a survey conducted during February 2020.

Four land types were identified within the Palm Valley clearance area as described in Table 5-39 and shown in Figure 5-35.

Table 5-39 Land Types (Palm Valley-12 Well)

Land type	Description	Photograph
PV-A	Undulating rocky plateau; north of access road. Shallow pale brown sandy loam soils; with accumulation in minor deposition areas. Soil cover is low (estimated at 10 to 15%). Low shrubland of <i>Acacia kempeana</i> and <i>Eucalyptus sessilis</i> over spinifex (<i>Triodia brizoides</i> and <i>Triodia melvillei</i>). No upper stratum present. Other common shrub layer species include <i>Scaevola spinescens</i> and <i>Senna artemisioides</i> subsp. <i>artemisioides</i>. Majority of area was burnt in 2002.	

Land type	Description	Photograph
PV-B	Undulating rocky plateau; south of access road Very shallow pale brown sandy loam soils. Low open woodland of <i>Acacia macdonnellensis</i> subsp. <i>macdonnellensis</i> and <i>Eucalyptus sessilis</i> over spinifex (<i>Triodia melvillei</i> and <i>Triodia brizoides</i>). Occasional <i>Acacia aneura</i> var. <i>Holey trunk</i> – including one patch to south east corner of survey area that is estimate to be >100 years old (based on trunk diameter). No recent fires, last fire approximately in the 1970s (based on small size of Hill Mulga).	
PV-C	Steep rocky north facing gullies. Skeletal soils; shallow pale brown sandy loams. Low open shrubland (common species included <i>Acacia macdonnellensis</i> subsp. <i>macdonnellensis</i>, <i>Acacia melleodora</i>, <i>Acacia kempeana</i>, <i>Stenanthemum centrale</i>, <i>Olearia ferresii</i>, <i>Ozothamnus kempei</i>) over spinifex (<i>Triodia brizoides</i> and <i>Triodia melvillei</i>) and to a lesser extent <i>Eriachne mucronata</i> and <i>Cymbopogon ambiguus</i>. Occasional emergent trees <i>Corymbia aparrerinja</i> and <i>Callitris glaucophylla</i>. Majority of area was burnt in 2002.	
PV-D	Steep rocky south facing gullies. Skeletal soils; shallow pale brown sandy loams. Low open woodland of <i>Acacia macdonnellensis</i> subsp. <i>macdonnellensis</i> +/- <i>Eucalyptus sessilis</i> over spinifex (<i>Triodia melvillei</i>). Other common species include <i>Psydrax latifolia</i>, <i>Corymbia eremaea</i>, <i>Callitris glaucophylla</i>, <i>Eriachne mucronata</i> and <i>Triodia brizoides</i>. No recent fires, last fire approximately in the 1970s (based on small size of Hill Mulga).	

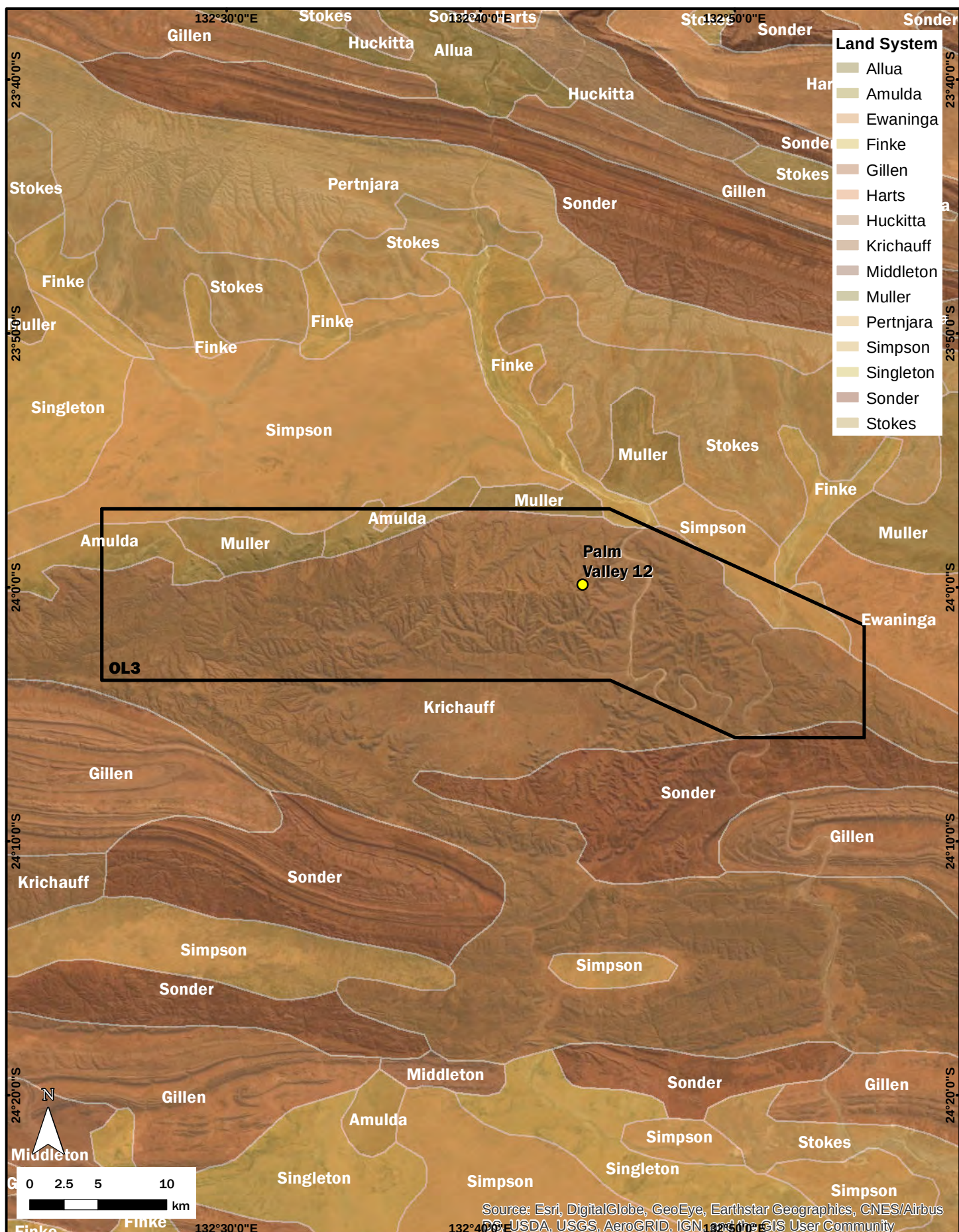


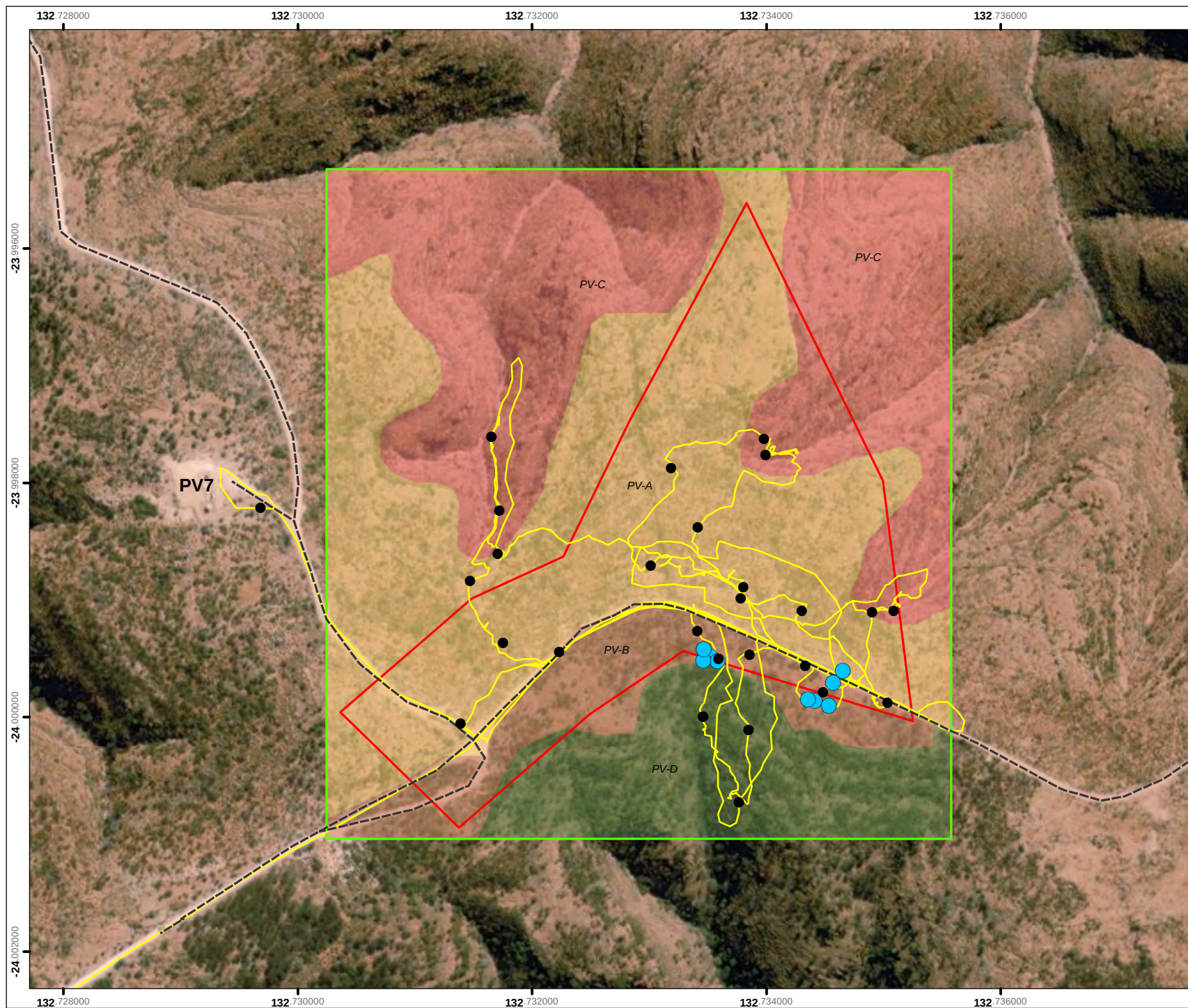
Figure 5-35: Land Systems (Palm Valley 12 Well)

- Indicative well location
- Permit

ID: 0523-04
Rev:
Date: 1/06/2020
Map Scale is 1:366,170 when printed at A4
Coordinate System: GCS GDA 1994
Land Systems - Department of Environment and Natural Resources

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PALM VALLEY 12

Survey data

- Existing roads
- PV12 clearance area
- PV12 ecological survey area
- Survey transects
- Check sites
- Eucalyptus lucens records (Near Threatened species)

NOTE: The low shrub *Stenanthemum centrale* (Near Threatened species) was recorded within land type PV-A and PV-C. This species is relatively common through the surrounding Krichauff and James Ranges.

Land types (1:5,000) (ground-truthed)

- PV-A: undulating rocky plateau (north of access road) with low shrubland of *Acacia kempeana* and *Eucalyptus sessilis* over spinifex (*Triodia brizoides* and *Triodia melvillei*)
- PV-B: undulating rocky plateau (south of access road) with low open woodland of *Acacia macdonnellensis* and *Eucalyptus sessilis* over spinifex (*Triodia melvillei* and *Triodia brizoides*)
- PV-C: steep rocky north facing gullies with low open shrubland (common species - *Acacia macdonnellensis*, *A. melleodora*, *A. kempeana*, *Stenanthemum centrale*, *Olearia ferresii*, *Ozothamnus kempei*) over spinifex (*Triodia brizoides* and *Triodia melvillei*)
- PV-D: steep rocky south facing gullies with low open woodland of *Acacia macdonnellensis* +/- *Eucalyptus sessilis* over spinifex (*Triodia melvillei*)



0 25 50 100
Metres



MAP INFORMATION

Scale: 1:5,000 @ A4
Projection: GCS GDA 1994
Date Saved: 27/04/2020
Client: Enviro-Value
Author / Mapper: TR

DATA SOURCE

Clearance area: Central Petroleum
Survey data: EcOz (Feb 2020)
Imagery: Maxar (7/6/2019)

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

Figure 5-36. Land types present within the PV12 clearance area

5.4.1.6 Groundwater

The Palm Valley-12 well is located in the Amadeus Basin, an elongated east-west aligned sedimentary basin that covers an area of approximately 170 000 km² in central Australia. Lloyd and Jacobson (1987) define two main hydrogeological domains within the Amadeus Basin: the north-central area has broad folding associated with extensive and mappable sandstone formations, elsewhere in the basin greater deformation has resulted in the development of a regional fractured rock groundwater systems.

The Palm Valley-12 well is located the Palm Valley gas field in the north-central region of the basin and overlies a series of regional scale productive formations including the Hermannsburg Sandstone, the Mereenie Sandstone and the Pacoota Sandstone.

Table 5-40 provides a summary of the formation depths, thickness and groundwater potential of formations beneath PV12 from the surface units down to the Arumbera Sandstone, the lowermost target for the drilling. Note that exploration of deeper formations is limited in this part of the Amadeus Basin and consequently little is known about the groundwater characteristics of formations below the Pacoota Sandstone.

Table 5-40 Summary of Stratigraphy and Groundwater Occurrence (Palm Valley-12 Well)

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Hermannsburg Sandstone	Surface	395	Hard, silty sandstone	Good potential for useable groundwater supplies across the region	Fresh	Yes
Parke Siltstone	395	35	Siltstone, minor claystone	Poor	Not known	No
Mereenie Sandstone	430	570	Quartz sandstone	Good potential for useable groundwater supplies across the region	Fresh	Yes
Carmichael Sandstone	1000	80	Interbedded sandstone, siltstone and mudstone	Potential for useable groundwater supplies across the region	Not known	Yes
Stokes Siltstone	1080	325	Claystone, siltstone	Poor	Not known	No
Stairway Sandstone	1405	285	Silty sandstone with interbedded siltstone	Gas Reservoir	Not known	No
Horn Valley Siltstone	1690	90	Claystone with interbedded marl and limestone	Poor	Not known	No
Pacoota Sandstone	1780	505	Sandstone with siltstone and shale	Gas Reservoir	Saline	No
Goyder Formation	2285	520	Shale, siltstone and dolomite	Not known	Not known	No
Hugh River Shale	2805	340	Siltstone, shale, limestone, dolomite	Not known	Not known	No

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Chandler Formation	3145	290	Silty halite, minor limestone, mudstone	Poor Likely hypersaline	Saline	No
Arumbera Sandstone	3435	555	Interbedded sandstone, siltstone, shale	Gas Reservoir?	Not known	No

*Depths and thickness based on CP prognosis for Palm Valley-12 well

^ Water quality assessment is based on bore data or formation water quality from Palm Valley well completion reports

The Palm Valley-12 well is located in outcrop of the Hermannsburg Sandstone (refer Figure 5-37) - a hard, fine to medium grained poorly sorted sandstone with lithic inclusions. Primary porosity in the formation is low and successful bores typically rely on secondary permeability (i.e. enhanced permeability from intersecting fractures and joints). Although it forms a regional scale groundwater system, the Hermannsburg Sandstone provides poorer supply potential relative to the Mereenie Sandstone and the Pacoota Sandstone. Transmissivity ranges from 0.2 – 20 m²/day (Macqueen and Knott, 1982), though in the vicinity of the Palm Valley-12 well is likely to be toward the lower end of this range (Childs, 1990). Bore yields typically range from 0.5 – 2.5 L/s (NRETA, 2007). Due to the low permeability of the formation successful production bores often screen large intervals (100s of metres) to secure reasonable yields and well losses are significant representing up to 50% of pumping drawdown (Childs, 1990). This is attested to in the number of abandoned bores identified in the local area (see Table 5-40).

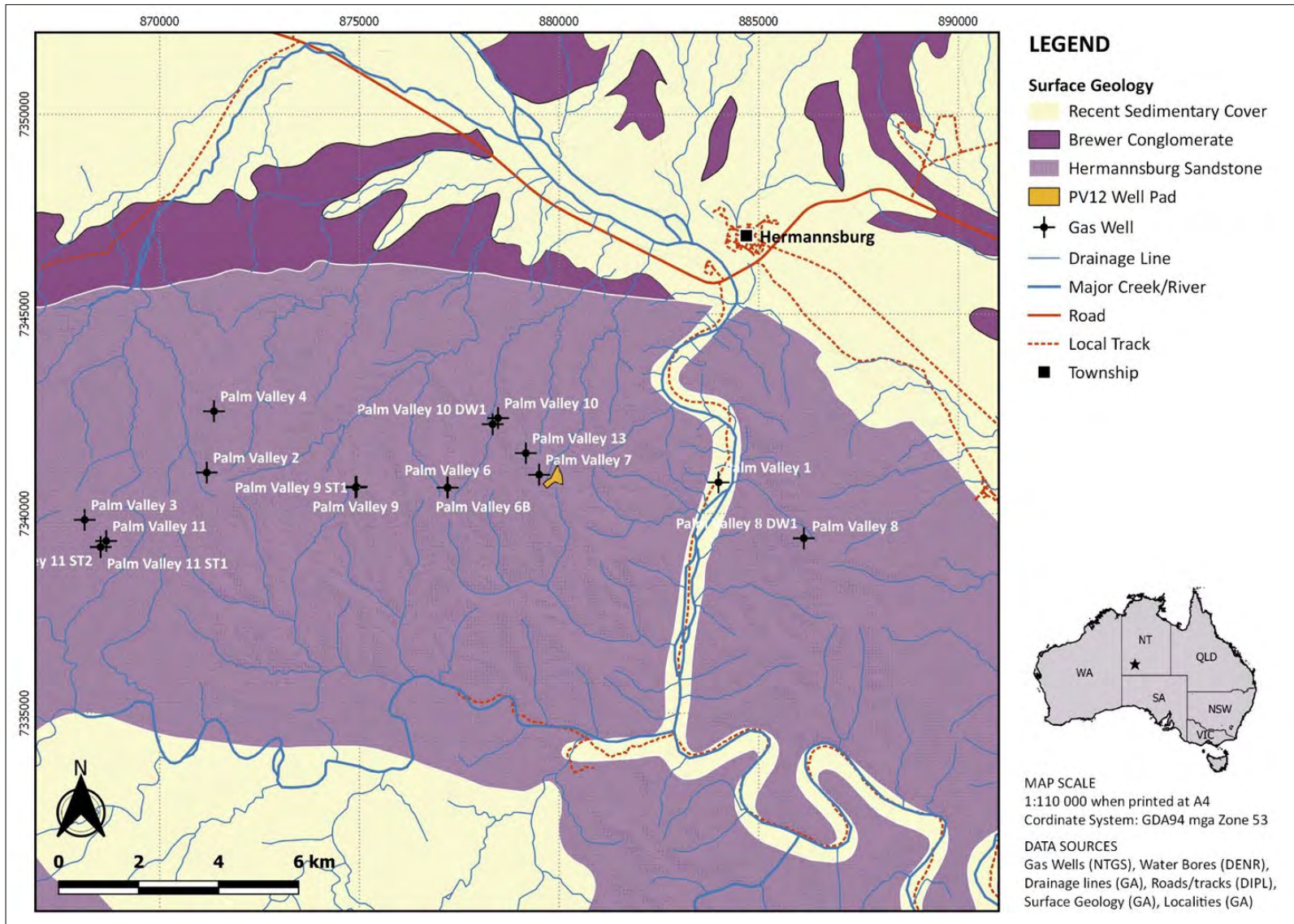


Figure 5-37 Surface Geology (Palm Valley-12 Well)

The regional groundwater flow direction in the Hermannsburg Sandstone is from west to east, though flow patterns are discordant and locally may follow the topographic gradient (Wischusen et al, 2002). Groundwater levels are shallow (<5 m) and artesian conditions (i.e. flowing bores) have been observed in the vicinity of the Palm Valley-12 well (e.g. RN006503 – see Table 5-41). Artesian conditions also support a number of springs both to the north of the Palm Valley-12 well on the edge of the Krichauff Range and south of the well site in the Finke Gorge National Park. Groundwater quality in the Hermannsburg Sandstone is variable but is typically of good to fair potable quality²⁵.

Existing groundwater users in the vicinity of Palm Valley-12 well include the Hermannsburg community, which sources its water supply from a borefield 5 km north of the well site sourced from the Hermannsburg Sandstone. The Hermannsburg Sandstone is also the water supply for the Palm Valley ranger station and campground, roughly 6 km to the south of the Palm Valley-12 well.

The nearest monitoring bore (RN015006) is located 5 km north of the Palm Valley-12 well and monitors the Hermannsburg Sandstone. Monitoring is undertaken by Power Water Corporation and current time series data is not readily available.

A groundwater source review of the Hermannsburg water supply (Childs, 1990) reports on groundwater trends in the borefield during the late 1980s. The report suggests that water levels show a recharge response to large rainfall events that is consistent with a recharge zone located to the south of the borefield, and suggests that recharge to the aquifer predominantly occurs where ephemeral drainage lines cut across the outcropping sandstone (Childs, 1990). Palm Valley-12 well is therefore likely to be within the recharge zone for the Hermannsburg community supply as it is located at the headwaters of a drainage line that cuts across the recharge zone.

At least two casing strings will be installed and fully pressure cemented across the Hermannsburg Sandstone in the Palm Valley-12 well (Section 4.4.3).

The Mereenie Sandstone comprises a loose, fine to very coarse-grained quartz sandstone that reaches a thickness of 570 m at the Palm Valley-12 well. The Mereenie Sandstone is separated from the overlying Hermannsburg Sandstone by the low permeability Parkes Siltstone. The Mereenie Sandstone is regionally extensive and is of particular significance in the north-east of the Amadeus Basin where it provides the water supply for Alice Springs. The dominant groundwater flow direction in the Mereenie Sandstone is to the east (Lloyd and Jacobson, 1987). Bore yields of up to 100 L/s have been recorded in the aquifer at Roe Creek (Alice Springs), though this is attributed to very high secondary permeability (Macqueen and Knott, 1982) and is not representative of the aquifer regionally.

There are no bores constructed in the Mereenie Sandstone within 10 km of the Palm Valley-12 well. Water samples collected during the drilling of gas wells Palm Valley 6 and Palm Valley 7 suggest groundwater quality is of poor potable quality (TDS - 1,100 mg/L). Transmissivities of up to 4,000 m²/day have been observed in the Mereenie Sandstone though 600 m²/day is considered representative for the aquifer at a regional scale (Macqueen and Knott, 1982). The Mereenie Sandstone overlies and is in limited hydraulic connection with the Carmichael Sandstone (Lloyd and Jacobson, 1987), which comprises interbedded sandstone, siltstone and mudstone. The formation contains limited groundwater resources and is of notably lower permeability than the overlying Mereenie Sandstone.

The Pacoota Sandstone is the lowermost formation with known groundwater supply potential within the Amadeus Basin sequence. At Palm Valley, the formation hosts a gas reservoir with petroleum drilling indicating groundwater within the formation is saline and over-pressured (Lloyd and Jacobson, 1987). Locally, the permeability of the Pacoota Sandstone is enhanced by fracturing and shows

²⁵ The Australian Drinking Water Guidelines (ADWG, 2011) do not identify health guideline value for total dissolved solids (TDS), as there are no health effects directly attributable to TDS. However, for good palatability total dissolved solids in drinking water should not exceed 600 mg/L, fair palatability ranges from 600 – 900 mg/L and poor palatability from 900 – 1200 mg/L. The ADWG identify TDS in excess of 1,200 mg/L as unpalatable.

connection with gas resources in the overlying Horn Valley Siltstone and Stairway Sandstone though it is isolated from potential productive groundwater supplies in the Mereenie Sandstone by the Stokes Siltstone. The regional flow direction in the Pacoota Sandstone is from east to west, though local flow directions in the vicinity of the Palm Valley field are complex due to the overpressure conditions.

5.4.1.6.1 Groundwater Bores

A search of the groundwater bores on NR Maps²⁶ identified 54 registered bores within a 10 km radius of the proposed Palm Valley-12 well. Eleven of these bores fall within a 5 km radius of the Palm Valley-12 well. Key details for these bores are summarised in Table 5-41.

Bore locations are shown relative to the Palm Valley-12 well in Figure 5-38. The majority of bores are current or historic production bores for the Hermannsburg town water supply.

The Palm Valley-12 well is not located with a Northern Territory Water Control District. Water supplies for the Palm Valley-12 drilling campaign will be sourced from a commercial supplier, therefore there is no potential for impacts to local bore supplies.

Table 5-41 Summary of Registered Bores (Palm Valley-12 Well)

Bore ID	Distance to Palm Valley-12 well (km)	Aquifer	Constructed Depth (mBGL)	Groundwater		Status
				EC (µS/cm)	Depth (mBGL)	
RN004704	3.4	Hermannsburg Sandstone	2	1,330	6.7	Abandoned ¹
RN006503	3.6	Hermannsburg Sandstone	2	1,330	Artesian	Uncapped flowing exploration bore
RN010953	3.8	Hermannsburg Sandstone	-	-	-	Palm Valley No. 1 Oil Bore*
RN003280	4.6	Hermannsburg Sandstone	55	1,140	-	Abandoned production bore Hermannsburg
RN015007	5.0	Hermannsburg Sandstone	221	1,080	23.4	Production bore Hermannsburg
RN018289	5.0	Hermannsburg Sandstone	6	-	-	Abandoned during drilling
RN007175	5.0	Hermannsburg Sandstone	3	1,130	3	Abandoned production bore Hermannsburg
RN007291	5.1	Hermannsburg Sandstone	3	1,070	4	Abandoned production bore Hermannsburg
RN018288	5.1	Hermannsburg Sandstone	6	-	-	Abandoned during drilling
RN014165	5.1	Hermannsburg Sandstone	167	1,080	15.35	Production bore Hermannsburg
RN018730	5.1	Hermannsburg Sandstone	174	-	6.7	Production bore Hermannsburg

¹ was not located by CP on 20 February 2020. Statement of bore location likely to be incorrect

* was not located by CP on 20 February 2020. Likely to be Palm Valley 1 gas well

²⁶ <https://nrmaps.nt.gov.au/nrmaps.html>

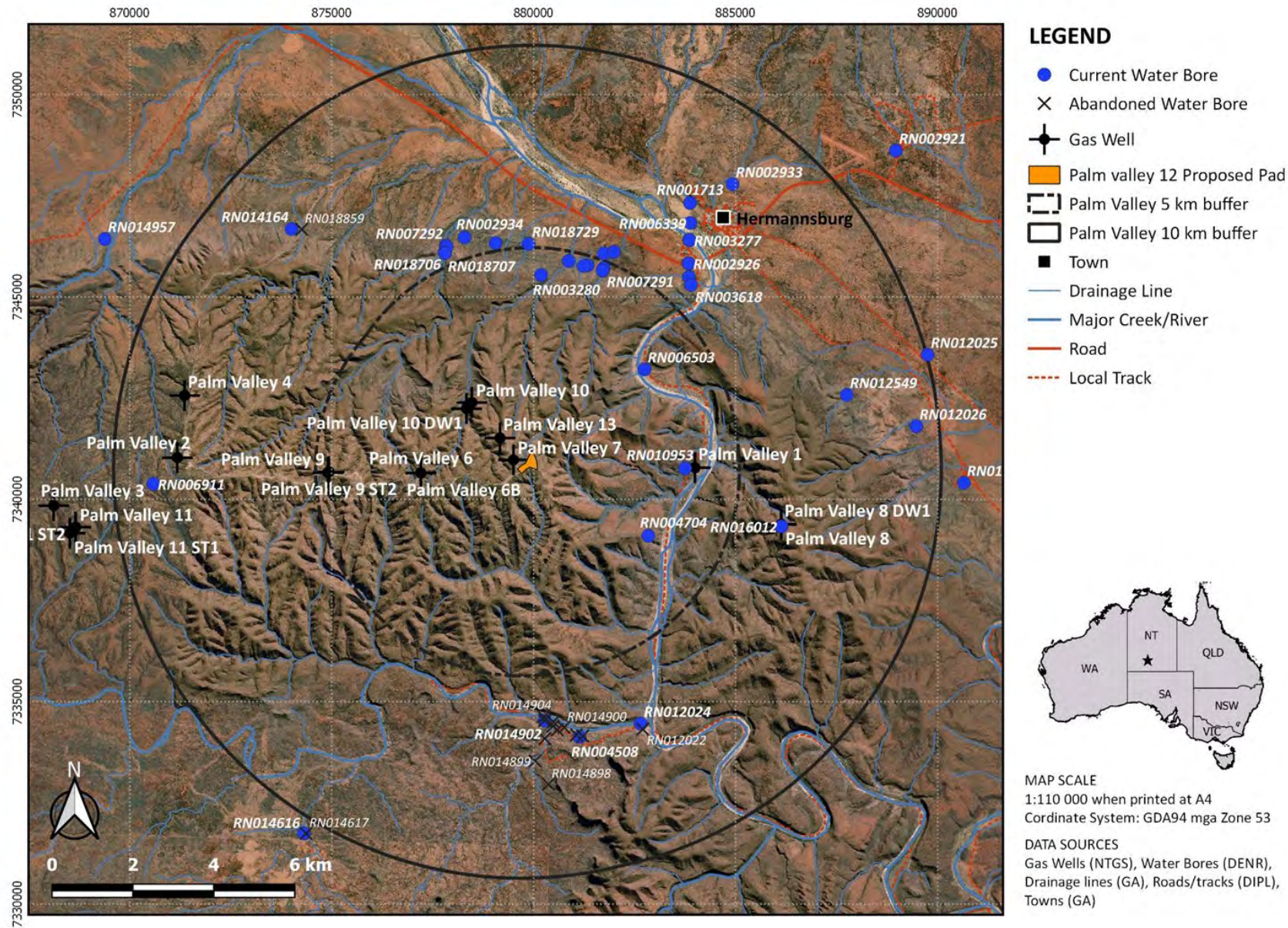


Figure 5-38 Registered Groundwater Bores within 10 km (Palm Valley-12 Well)

5.4.1.6.2 Baseline Groundwater Sampling

A baseline groundwater sample was collected from bore RN006503, the closest active bore to the Palm Valley-12 well that could be located, on February 2020. The bore is an uncapped artesian bore with a flow rate estimated at less than 1L/minute.

Groundwater was collected in new laboratory supplied bottles, which were transported to ALS laboratories in Brisbane for analysis under standard chain of custody protocols. The groundwater was analysed for physical chemistry, major ions, alkalinity, nutrients, silica, dissolved and total metals, dissolved hydrocarbon gases, PAH, TPH, TRH and BTEX.

A summary of water level, field parameters laboratory results and assessment against Australian drinking water guidelines (NHMRC, NRMCC 2011) and stock watering guidelines (ANZECC 2000), where applicable is provided in Appendix 2. All analytes are below drinking water health related guidelines and stock watering guidelines. No detections of hydrocarbon gases or products were recorded.

5.4.1.6.3 Wetlands, Springs and Groundwater Dependant Ecosystems

A series of springs are mapped within a 10 km radius of the Palm Valley-12 well (Figure 5-39), details which are sourced from NR Maps²⁷ are summarised in Table 5-42 .

These springs are groundwater discharge features from the Hermannsburg Sandstone aquifer and typically occur along prominent fractures and joints in the rock where secondary permeability is enhanced (Wischusen et al, 2002). Of particular significance is the groundwater discharge in Palm Valley, located 6 km south of the Palm Valley-12 well, which supports a rare and relic assemblage of flora including the red cabbage palm (*Livistona mariae*).

Water supplies for the Palm Valley-12 drilling campaign will be sourced from a commercial supplier, therefore there is no potential for impacts to springs or GDEs.

²⁷ Springs of the Northern Territory Layer

http://www.ntlis.nt.gov.au/metadata/export_data?type=html&metadata_id=E9D78F668FC02B33E040CD9B214403C3

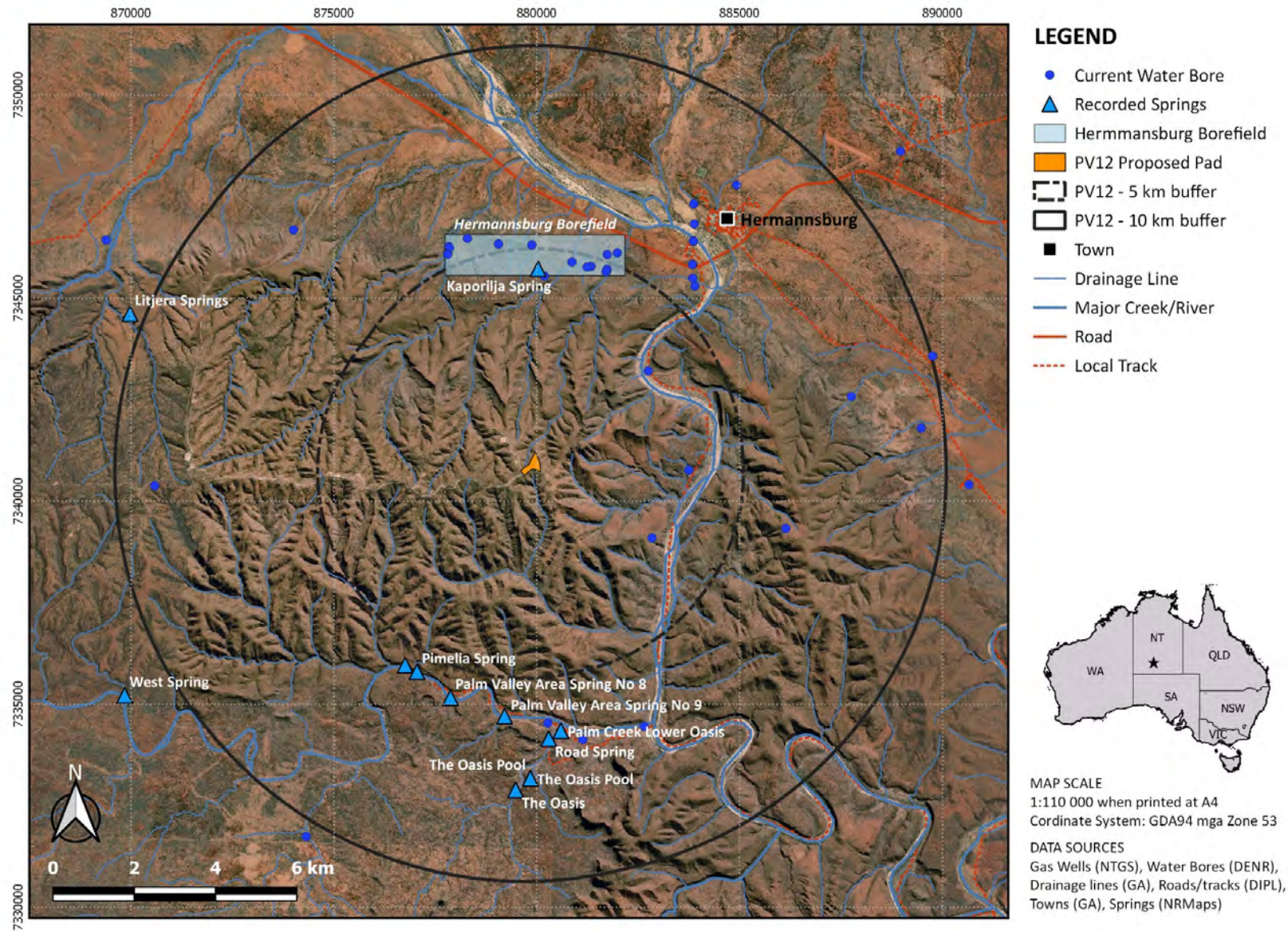


Figure 5-39 Mapped Springs within 10km (Palm Valley-12 Well)

Table 5-42 Summary of Springs within 10 km (Palm Valley-12 Well)

Spring Name	Distance from Palm Valley-12 Well (km)	Latitude (GDA94)	Longitude (GDA94)	Source Aquifer	Water Quality (EC, $\mu\text{S}/\text{cm}$)
Kaporilja Spring	4.7	-23.955	132.7333	Not identified	840
Pimelia Spring	5.9	-24.0452	132.7066	Hermannsburg Sandstone	-
No name	5.9	-24.0438	132.7037	Hermannsburg Sandstone	-
Palm Valley Area Spring No 8	6.1	-24.0507	132.7149	Hermannsburg Sandstone	-
Palm Valley Area Spring No 9	6.3	-24.0545	132.7281	Hermannsburg Sandstone	-
Palm Creek Lower Oasis	6.6	-24.0574	132.7418	Hermannsburg Sandstone	-
Road Spring	6.8	-24.0592	132.7389	Hermannsburg Sandstone	774
The Oasis Pool	7.8	-24.0681	132.7347	Hermannsburg Sandstone	892
The Oasis	8.0	-24.0708	132.7312	Not identified	-
Litjera Springs	10.5	-23.9674	132.6349	Not identified	990
West Spring	11.5	-24.0521	132.636	Hermannsburg Sandstone	802

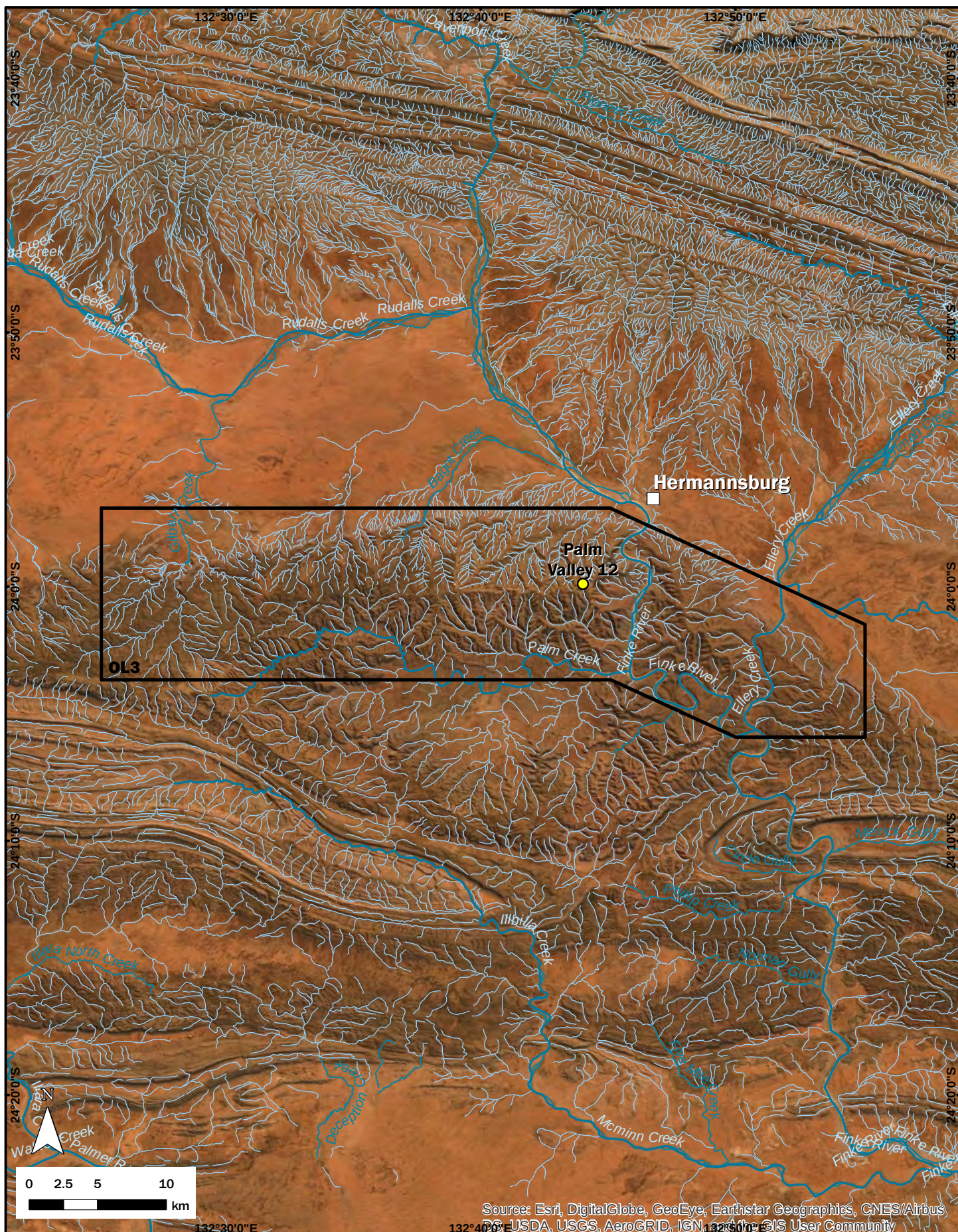
5.4.1.7 Surface Water

The Palm Valley-12 well is situated within the Finke River Basin, connected to the nationally significant Lake Eyre basin. The Lake Eyre basin covers almost one-sixth of Australia and is one of the world's largest internally draining river systems. The area supports a range of nationally important natural, social and economic values. All community sectors across the Lake Eyre Basin, scientists and Governments, are involved in a collaborative effort (principally under the Lake Eyre Basin Intergovernmental Agreement) to ensure that the health of the unique river systems of the basin can be maintained (Australian Government, 2011).

There are multiple drainage lines that join with the two major ephemeral creeks (Palm and Ellery) located within the Palm Valley development area. Both these creeks eventually connect to the Finke River (which traverses through the eastern section of the development area). The Finke River runs out into Lake Eyre during extreme events.

A map of the surface hydrology of the proposed well site area is available in Figure 5-40. The buffer distance to stream orders from the disturbance areas is in line with the recommended widths specified in the DEPWS Land Clearing Guidelines (2019).

Flood modelling of the proposed Palm Valley-12 well lease has been undertaken and the well lease is not located within the 1% AEP rainfall event (refer Appendix 1). As such, no flood mitigation works is required at this well lease.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus
 DG, USDA, USGS, AeroGRID, IGN, 13rd Floor, GIS User Community

ID: 0523-07

Rev:

Date: 1/06/2020

Map Scale is 1:366,170 when printed at A4
 Coordinate System: GCS GDA 1994

Northern Territory Mapped Streams - Department
 of Environment and Natural Resources

Figure 5-40 Surface hydrology (Palm Valley 12 Well)

- Indicative well location
- Town / Location
- Permit
- Major Drainage
- Minor Drainage
- Streams



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5.4.2 Natural Environment

5.4.2.1 Bioregions

The Palm Valley-12 well is located within the MacDonnell Ranges bioregion (refer Figure 5-41) as classified by (Baker, et al., 2005) and described in Table 5-43 .

Table 5-43 Bioregions (Palm Valley-12 Well)

Bioregion ²⁸	Topography	Geology	Soils	Vegetation
MacDonnell Ranges	High relief ranges and foothills enclose some broad plains and watercourses	mostly sedimentary rocks in the Amadeus Basin and crystalline metamorphic rocks in the Arunta Block	Generally skeletal or shallow sands on the rocky hills with earthy sands and deep loamy alluvium on the lowlands	Dominant vegetation spinifex hummock grassland, sparse acacia shrub lands and woodlands along watercourses.

5.4.2.2 Sites of Conservation Significance

There are currently 67 Sites of Conservation Significance (SOCS) identified by the Northern Territory government. SOCS are areas defined by the Northern Territory government as important sites for biodiversity conservation that need further protecting.

The Palm Valley-12 well clearance area is located within the Greater MacDonnell Ranges SOCS – the assessment of potential impacts to the SOCS has been undertaken during baseline surveys. Figure 5-31 provides an overview of the Palm Valley-12 well clearance area and the Greater MacDonnell Ranges SOCS.

5.4.2.3 Sites of Botanical Significance

A SOBS is an area that has been defined (by White et al. 2000) to hold important and / or unique botanical assemblages that require protection. SOBS are designated as either nationally significant (41 sites), bioregionally significant (79 sites) or of undetermined significance (33 sites).

Currently there is no specific legislation attached to SOBS, although protection of the SOBS is administered through other pieces of legislation (e.g. TPWC Act etc)

The Palm Valley-12 well is located within the Palm Valley SOBS which has been designated as nationally significant.

²⁸ (Baker, et al., 2005)

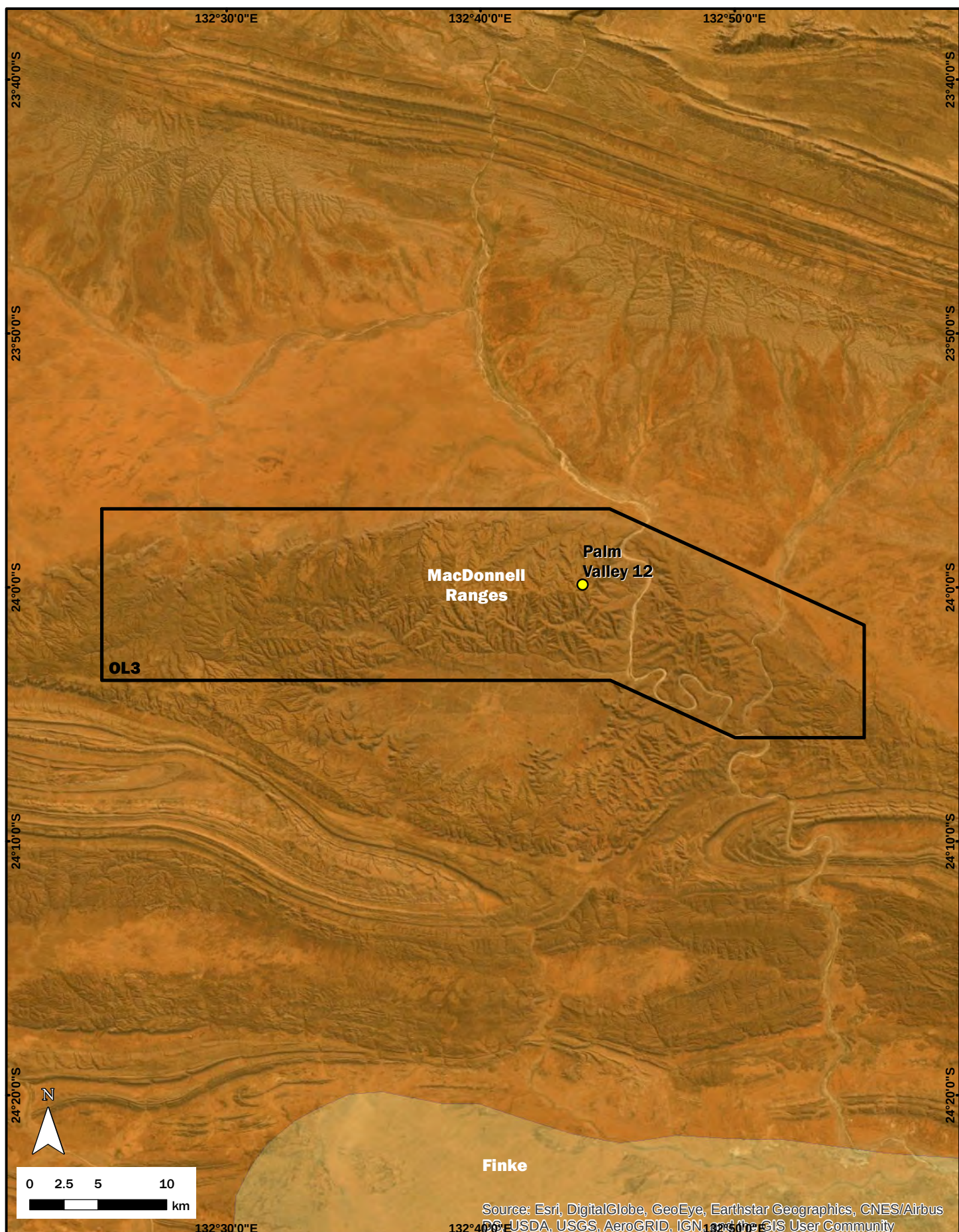
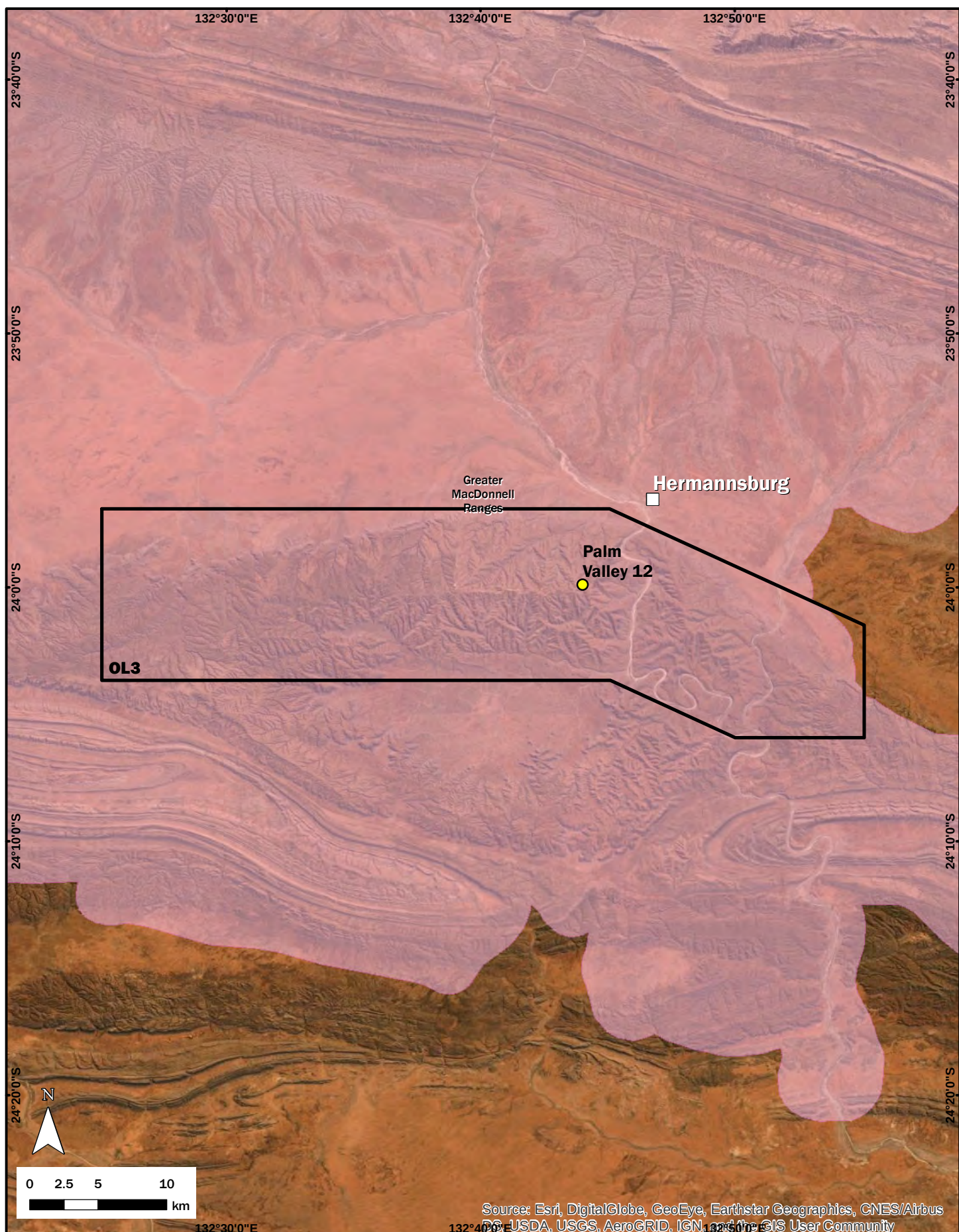


Figure 5-41 Bioregions (Palm Valley 12 Well)

- Indicative well location
- Permit
- IBRA region
- Finke
- MacDonnell Ranges



ID: 0523-02
 Rev:
 Date: 1/06/2020
 Map Scale is 1:366,170 when printed at A4
 Coordinate System: GCS GDA 1994
 Interim Biogeographic Regionalisation for Australia
 (IBRA) version 7.0 - Australian Government
 Department of Sustainability, Environment, Water,
 Population and Communities



ID: 0523-03
 Rev:
 Date: 1/06/2020
 Map Scale is 1:366,170 when printed at A4
 Coordinate System: GCS GDA 1994
 Sites of Conservation Significance from
 Department
 of Environment and Natural Resources -
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Figure 5-42 SOCS (Palm Valley 12 Well)

- Indicative well location
- Town / Location
- Permit
- Sites of Conservation Significance
- International



5.4.2.4 Threatened Ecological Communities

No threatened ecological communities were identified within the proposed Palm Valley-12 well clearance area.

5.4.2.5 Conservation Significant Flora

A flora species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Flora Atlas within the sub-bioregion of the Palm Valley-12 well clearance area or
 - has been recorded during an ecological assessment of the Palm Valley-12 well clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Palm Valley-12 well clearance area or
 - has been recorded during field surveys of the Palm Valley-12 well clearance area.

Based on the results of desktop searches, previous field survey (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Palm Valley-12 well clearance area. Table 5-44 provides a summary of flora species of conservation significance which may be present within the Palm Valley-12 well clearance area and identifies the likelihood of each species occurring based on ground truthing within the Palm Valley-12 well clearance area.

Two NT species under the TPWC Act were detected during the ecological assessment, being:

- Shiny-leaved Mallee (*Eucalyptus lucens*) – located mostly south of the existing access road in land type PV-B
- *Stenanthemum centrale* - scattered to patchily common on the plateau (land type PV-A) and northern gullies (land type PV-C).

In addition to the two NT species identified during the ecological assessment, forty-seven other flora species within the Palm Valley-12 well clearance area were identified, of which:

- One was an introduced species (*Cenchrus ciliaris*)
- Forty-six species are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

Table 5-44 Conservation Significant Flora (Palm Valley-12 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Survey Result	Likelihood of Occurrence ²⁹
<i>Acacia latzii</i>	Tjilpi Wattle, Latz's Wattle	VU	VU	Likely to occur	0	No	Unlikely
<i>Actinotus schwarzii</i>	Desert Flannel-flower	VU	VU	Likely to occur	0	No	Unlikely
<i>Amperea spicata</i>	George Gill Range Cliff-bush	VU	-	-	9	No	Unlikely
<i>Baumea arthrophylla</i>	Baumea	EN	-	-	3	No	Unlikely
<i>Bolboschoenus caldwellii</i>	Bolboschoenus	EN	-	-	5	No	Unlikely

²⁹ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Survey Result	Likelihood of Occurrence ²⁹
<i>Eucalyptus lucens</i>	Shiny-leaved Mallee	NT	-	-	0	Yes	Likely
<i>Eremophila prostrata</i>	Rainbow Valley Fuchsia Bush	NT	VU	-	10	No	Unlikely
<i>Livistona mariae</i> subsp. <i>mariae</i>	Red Cabbage Palm	EN	EN	Known to occur	22	No	Unlikely
<i>Macrozamia macdonnellii</i>	MacDonnell Ranges Cycad	NT	VU	Known to occur	25	No	Unlikely
<i>Minuria tridens</i>	Minnie Daisy	VU	VU	Known to occur	22	No	Unlikely
<i>Olearia macdonnellensis</i>	Olearia	EN	VU	Likely to occur	0	No	Unlikely
<i>Prostanthera schultzei</i>	Wrixonia	VU	VU	Likely to occur	0	No	Unlikely
<i>Stenanthemum centrale</i>	-	NT	-	-	0	Yes	Likely
<i>Santalum acuminatum</i>	Desert Quandong, Native Peach	VU	-	-	32	No	Unlikely
<i>Thryptomene hexandra</i>	Palm Valley Myrtle	NT	VU	Likely to occur	20	No	Unlikely

5.4.2.6 Conservation Significant Fauna

A fauna species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Fauna Atlas within the sub-bioregion of the Palm Valley-12 clearance area or
 - has been recorded during an ecological assessment of the Palm Valley-12 clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Palm Valley-12 clearance area or
 - has been recorded during an ecological assessment of the Palm Valley-12 clearance area.

Based on the results of desktop searches, previous ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Palm Valley-12 clearance area, Table 5-45 provides a summary of flora species of conservation significance which may be present within the Palm Valley-12 well clearance area and identifies the likelihood of each species occurring based on ground truthing within the Palm Valley-12 well clearance area.

Whilst no conservation significant fauna were detected during the baseline ecological assessment in February 2020, three fauna species were recorded within the Palm Valley-12 well clearance area of which:

- One introduced species (rabbit)
- One reptile (ring tailed dragon) and one mammal (common wallaroo), both listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full details of these species.

In addition, Key habitat features within the survey area were identified - namely sandstone plateaux and the 'head' of steep rocky sandstone gullies. The survey in Appendix 2 indicates that the area is unlikely to support threatened species, which includes the Grey Falcon.

Table 5-45 Conservation Significant Fauna (Palm Valley-12 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Survey Result	Likelihood of Occurrence ³⁰
<i>Amytornis modestus</i>	Thick-billed Grasswren (Mac Range)	EW	VU	-	23	No	Unlikely
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CR	May occur	0	No	Unlikely
<i>Erythrorhynchus radiatus</i>	Red Goshawk	VU	VU	May occur	1	No	Unlikely
<i>Falco hypoleucos</i>	Grey Falcon	VU	-	-	15	No	Unlikely
<i>Leipoa ocellata</i>	Malleefowl	CR	VU	-	2	No	Unlikely
<i>Melanodryas cucullata melvillensis</i>	Hooded Robin (Tiwi)	CR	CR	-	2	No	Unlikely
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	May occur	0	No	Unlikely
<i>Polytelis alexandrae</i>	Princess Parrot	VU	VU	Known to occur	2	No	Unlikely
<i>Rostratula australis</i>	Australian Painted-snipe	VU	EN	May occur	1	No	Unlikely
<i>Liopholis kintorei</i>	Great Desert Skink	VU	VU	-	5	No	Unlikely
<i>Liopholis slateri</i>	Slater's Skink	VU	EN	Known to occur	88	No	Unlikely
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	VU	VU	-	7	No	Unlikely
<i>Dasyurus geoffroii</i>	Western Quoll	EW	VU	-	3	No	Unlikely
<i>Lagorchestes hirsutus</i>	Mala	EW	CR	-	2	No	Unlikely
<i>Macroderma gigas</i>	Ghost Bat	NT	VU	-	1	No	Unlikely
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	-	16	No	Unlikely
<i>Notoryctes typhlops</i>	Itjaritjari, Southern Marsupial Mole	VU	-	-	60	No	Unlikely
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby	NT	VU	Known to occur	655	No	Unlikely

³⁰ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Fauna Atlas Records	Survey Result	Likelihood of Occurrence ³⁰
<i>Trichosurus vulpecula</i>	Common Brushtail Possum (central)	EN	-	-	2	No	Unlikely
<i>Zyomys pedunculatus</i>	Central Rock-rat	EN	CR	Known to occur	0	No	Unlikely
<i>Chlamydogobius japalpa</i>	Finke Goby	VU	-	-	24	No	Unlikely
<i>Bothriembryon spenceri</i>	Spencer's Land Snail	VU	-	-	3	No	Unlikely
<i>Divellomelon hillieri</i>	a land snail	VU	-	-	28	No	Unlikely
<i>Granulomelon (formerly Basedowena) squamulosum</i>	a land snail	VU	-	-	64	No	Unlikely
<i>Granulomelon arcigerens</i>	West MacDonnell's Land Snail	VU	-	-	6	No	Unlikely
<i>Semotrachia elleryi</i>	Ellery Gorge Land Snail	VU	-	-	34	No	Unlikely
<i>Semotrachia esau</i>	a land snail	VU	-	-	186	No	Unlikely
<i>Semotrachia euzyga</i>	a land snail	EN	EN	-	3	No	Unlikely
<i>Semotrachia illarana</i>	a land snail	VU	-	-	13	No	Unlikely
<i>Sinumelon bednalli</i>	Bednall's Land Snail	NT	CR	-	8	No	Unlikely
<i>Tateropa (formerly Pilomena) aemula</i>	a land snail	VU	-	-	9	No	Unlikely

5.4.2.7 Weeds

Weeds managed under this EMP can be categorised via the following methods:

- WoNS – nationally agreed priority flora species for control and management. Weed species are determined based on rankings for invasiveness, potential to spread, and impact on socio-economic and environmental assets. There are currently 32 WoNS with each having an endorsed strategic plan which outlines tactics and actions for control
- Declared Weeds - species which have been identified for control, eradication, or prevention of entry in all or part of the Northern Territory under the *Weeds Management Act 2001*. Declared weeds can be of the following classes:
 - Class A – to be eradicated
 - Class B – growth and spread to be controlled
 - Class C – not to be introduced into the Northern Territory
- Priority / alert weeds – species which have been identified as a priority or alert weed species within the Alice Springs Regional Weed Management Plan 2013-2018.

Based on a 50 km radius from the Palm Valley-12 well clearance area the weeds identified in Table 5-46 have been recorded locally.

Table 5-46 Weed Records (Palm Valley-12 Well)

Scientific Name	Common Name	WoNS	Declared	Priority / Alert
<i>Alternanthera pungens</i>	Khaki weed		✓	
<i>Argemone ochroleuca</i>	Mexican poppy		✓	
<i>Cenchrus echinatus</i>	Mossman river grass		✓	
<i>Opuntia elatior</i>	Prickly pears - elatior	✓	✓	
<i>Opuntia stricta</i>	Prickly pears - stricta	✓	✓	
<i>Parkinsonia aculeata</i>	Parkinsonia	✓	✓	✓
<i>Prosopis pallida</i>	Mesquite	✓	✓	
<i>Ricinus communis</i>	Castor oil plant		✓	
<i>Sida cordifolia</i>	Sida - Flannel weed		✓	
<i>Tamarix aphylla</i>	Athel pine	✓	✓	✓
<i>Tribulus terrestris</i>	Caltrop - terrestris		✓	
<i>Xanthium spinosum</i>	Burr - Bathurst		✓	

A baseline weed assessment was undertaken of the Palm Valley-12 well clearance areas by a suitably qualified person in February 2020 and no WoNS or declared weeds were observed. Buffel Grass (*Cenchrus ciliaris*), a significant threat weed, was detected at scattered locations throughout the clearance areas.

5.4.2.8 Introduced Fauna (Pests)

An introduced fauna species is considered in this EMP to be of management concern if it is:

- Listed in the Northern Territory Fauna Atlas as “Introduced” and has been recorded within a 50 km buffer of the Palm Valley-12 well clearance area or has been recorded on ecological surveys of the area; or
- Identified as an invasive species by an EPBC PMST report within a 50 km buffer of the Palm Valley-12 well clearance area or has been recorded in ecological surveys of the area.

Table 5-47 provides an overview of the introduced fauna within 50 km of the Palm Valley-12 well clearance area.

Table 5-47 Introduced Fauna (Palm Valley-12 Well)

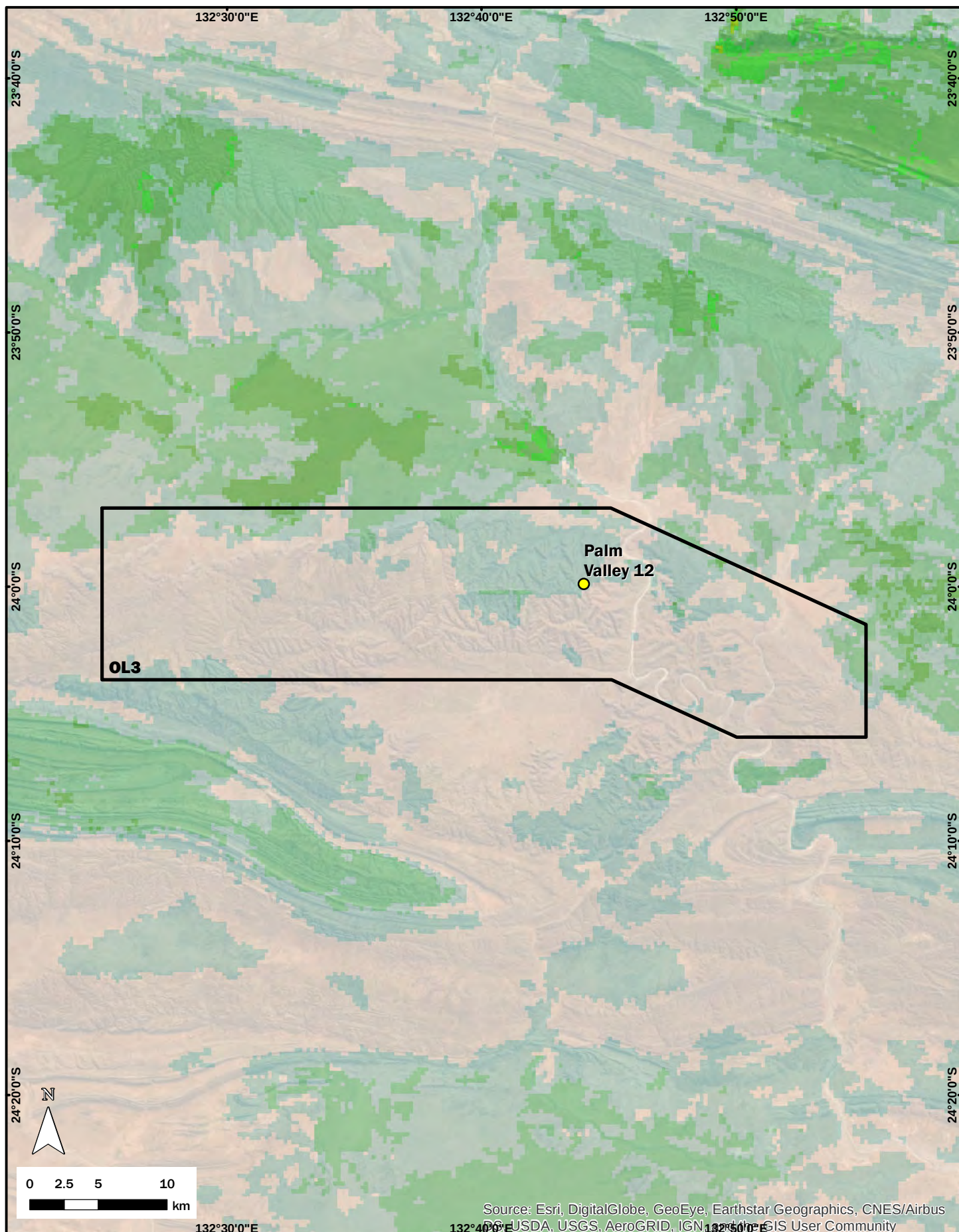
Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Bird	House Sparrow	<i>Passer domesticus</i>	✓		
Bird	Long-billed Corella	<i>Cacatua tenuirostris</i>	✓		
Bird	Rock Dove	<i>Columba livia</i>	✓		
Mammal	Camel	<i>Camelus dromedarius</i>	✓	✓	
Mammal	Cat	<i>Felis catus</i>	✓		
Mammal	Cattle	<i>Bos taurus</i>	✓	✓	✓
Mammal	Donkey	<i>Equus asinus</i>	✓		
Mammal	Fox	<i>Vulpes</i>	✓	✓	
Mammal	Horse	<i>Equus caballus</i>	✓	✓	
Mammal	House Mouse	<i>Mus musculus</i>	✓		

Class	Common name	Scientific name	Fauna Atlas	PMST Report	Ecological Survey
Mammal	Pig	<i>Sus scrofa</i>	✓		
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓	✓
Invertebrate	Monarch	<i>Danaus plexippus</i>	✓		

5.4.2.9 Fire History

NAFI records show the Palm Valley-12 well clearance area as having a low fire frequency with only one fire event since the year 2000. The last fire occurred on the northern side of the existing access road in 2002, which was a controlled burn organised and undertaken by rangers from Finke Gorge National Park in conjunction with Palm Valley Gas Field Operations Personnel. The majority of vegetation to the south was most likely burnt last in the 1970s.

Figure 5-43 shows the fire frequency at the clearance area and the wider Palm Valley field since the year 2000.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus
 DG, USDA, USGS, AeroGRID, IGN, 132°50'0"E

ID: 0523-11

Rev:

Date: 1/06/2020

Map Scale is 1:366,170 when printed at A4
 Coordinate System: GCS GDA 1994

Fire frequency - Darwin Centre for Bushfire
 Research 2020

Figure 5-43 Fire Scar Mapping (Palm Valley 12 Well)

- Indicative well location
- Permit
- Years burnt 2000 - 2019
- Unburnt
- 1

- 2
- 3
- 4
- 5



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5.4.3 Socio-economic Environment

An overview of the Palm Valley tenure and the locations of the Palm Valley-12 well in relation to populated places, roads, infrastructure and places of interests is provided in Figure 5-45.

5.4.3.1 Land Tenure

The proposed Palm Valley-12 well is located on Aboriginal land belonging to the Ntaria Aboriginal Land Trust. CP has existing relationships with the Ntaria Aboriginal Land Trust through other petroleum infrastructure located on their land.

There is no petroleum reserve block over OL3. Under the Petroleum Reserved Block Policy, OL3 is exempt as it is an operating and producing tenure.

5.4.3.2 Surrounding Populated Places

Populated areas close to Palm Valley-12 well include:

- Hermannsburg (the nearest population to the well) approximately 8km to the north east
- Glen Helen Resort, approximately 35km to the north
- Alice Springs, approximately 130km to the north-east

5.4.3.3 Traffic

Traffic is discussed in Section 4.8.6, which indicates that traffic volumes associated with the project will be minor.

In addition, further controls are and will be in place to reduce the impact and keep other road users safe. All access tracks associated with the Palm Valley Gas Field are clearly signed for authorised vehicles only. The turn in and turn offs of NT controlled roads are currently being used by CP operations and no further upgrades are required. Where vehicles associated with the Project may cause significant dust on NT controlled roads, vehicle speeds will be reduced. Oversized loads will be accompanied by an accredited Pilot.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the Palm Valley-12 well.

5.4.3.4 Noise Impact Assessment

A noise impact assessment was completed to predict noise levels during the drilling works at surrounding noise sensitive receptors, being the township of Hermannsburg to the northeast of Palm Valley -12, and camp sites within the Finke George National Park south of Palm Valley-12.

5.4.3.4.1 Acceptable Noise Levels

As required by Section A3.3 of the Code of Practice, the noise impact assessment for the drilling of Palm Valley-12 was conducted in accordance with the NT EPA's Northern Territory – Noise Management Framework Guideline³¹ (Noise Management Guideline).

Noise from the drilling of Palm Valley-12 aligns with the description of industrial noise as described in Section 3.2.2 and Table 2.1 of the Noise Management Guideline, where industrial noise sources includes noise from a mining, petroleum exploration activity, or petroleum extraction activity.

Under Section 3.2, noise levels from industrial activities, , are defined as intrusive at a residential receptor if they exceed the background noise levels (rating background noise levels (RBL)) by 5 decibels (dB) as

³¹ Northern Territory Environment Protection Authority, 2018. North Territory Noise Management Framework Guideline, version 0.1, dated September 2018.

measured over a 15-minute period ($L_{Aeq\ 15\ minute}$). Noise levels at or below 5 dB above RBL are generally considered acceptable.

Project specific assigned noise levels have been determined for the Palm Valley-12 drilling activities using the methodology described in Section 3.2.5 of the Noise Management Guideline. In the absence of measured RBLs, the 'minimum assumed RBLs' have been used and the 'minimum project intrusiveness noise levels' in Table 3.4 of the Noise Management Guideline have been adopted as the project specific assigned noise levels for residential receptors.

For other non-residential receptors, the amenity noise levels as per Section 3.2.5.2 and Table 3.5 of the Noise Management Guideline are used as the project specific assigned noise levels. The project specific assigned noise levels for residential receptors are the most stringent and are presented in Table 5-48

Table 5-48 Project specific assigned noise levels for the drilling of Palm Valley-12

Time of day	Minimum assumed rating background noise level (dB(A))	Minimum project intrusiveness noise levels ($L_{Aeq\ 15\ minute\ dB(A)}$)	Project specific assigned noise level – residential receptor ($L_{Aeq\ 15\ minute\ dB(A)}$)
Day	35	40	40
Evening	30	35	35
Night	30	35	35

Day period: 7:00am to 7:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays.

Evening period: 7:00pm to 10:00pm.

Night period 10:00pm to 7:00am Monday to Saturday or 10:00pm to 9:00am on Sundays and public holidays.

5.4.3.4.2 Sensitive Receptors

The sensitive receptors which have been identified within the project area (in the vicinity of Palm Valley-12, including their proximity to the site, are shown below in Table 5-49 and Figure 5-44

Table 5-49 Sensitive Receptors

Receptor ID	Receptor	X Coordinates ¹	Y Coordinates ¹	Distance to Palm Valley-12 (km)
1	Township of Hermannsburg	272682	7349005	8
2	Palm Valley camp sites within the Finke George National Park	270193	7337678	7.5

5.4.3.4.3 Noise Modelling Procedures

Noise modelling was conducted to predict noise levels at sensitive receptors using the environmental computer model, SoundPLAN. The model generates noise emission levels from a noise source to a receptor taking into account factors such as location of the noise source and receptor, source sound power levels and locations, terrain, distance attenuation, ground absorption, air absorption, shielding attenuation, and meteorological conditions. SoundPLAN uses the CONCAWE predication methodology which also incorporates the influence of wind effects and stability of the atmosphere on noise propagation.

Meteorological Conditions

In accordance with the Noise Management Guideline, consideration was given to the effects of prevailing and worst-case meteorological conditions (wind, temperature, humidity and temperature inversions) on noise propagation from the project.

Based on an analysis of the available meteorological data, the weather conditions used to assess the effect of neutral and adverse meteorological conditions are shown in Table 5-50 below. Temperature and humidity have been calculated from averaging historical data for the Alice Springs Airport Bureau of Meteorology (BOM) weather station (Station ID 015590).

Table 5-50 Meteorological Conditions – Neutral and Adverse

Parameter	Neutral Weather	Adverse Weather
Temperature	30oC	15oC
Humidity	30%	70%
Pasqual Stability Class	D	F
Wind Speed	0 m/s	2 m/s (Source > Receiver)

Terrain

3D terrain data has been utilised with the noise model to accurately model effects of the local terrain on noise propagation from the activities. 3D terrain was considered necessary due to the extensive landform features within the surrounding area, including Palm Valley-12 being located on a ridge while both assessed receptors are located within valleys.

The terrain data utilised in the noise model is supplied ‘Shuttle Radar Topography Mission’ (SRTM) elevation data which has some considerations that may impact on the accuracy of outputs from this noise modelling. These are well documented and known as it is inherent of Radar data, the 30m cell size, and the smoothing technique that Geoscience Australia has adopted for processing this data (as noted below, being copied from the SRTM metadata³²).

“DEM-S represents ground surface topography, excluding vegetation features, and has been smoothed to reduce noise and improve the representation of surface shape. An adaptive smoothing process applied more smoothing in flatter areas than hilly areas, and more smoothing in noisier areas than in less noisy areas. This DEM-S supports calculation of local terrain shape attributes such as slope, aspect and curvature that could not be reliably derived from the unsmoothed 1 second DEM because of noise.”

³² The use of the word ‘noise’ in this metadata blurb does not relate to the same ‘noise’ as per this current assessment – this refers to ‘noise’ within the surveyed terrain data such as where there is complex terrain and an increase in survey points/sharp variation in measurement heights.

Source Noise Emission Levels

It is expected that the noise emission from the activities would vary during the course of drilling at Palm Valley-12, however the highest noise level is most likely to occur during well cementing activities. Accordingly, typical noise emission levels³³ from well cementing forms the basis for this assessment, with a representative sound power level (SWL) presented in Table 5-51.

Table 5-51 Drilling Sound Power Level

Plant Item	Sound Power Level, dBA2										SWL per Unit dBA
	Octave Band Centre Frequency (Hz)										
	31.5	63	125	250	500	1,000	2,000	4,000	8,000		
Exploration Drilling – Well Cementing	79	92	95	105	107	114	114	107	97	118	

The following assumptions were included in the noise modelling:

- Drilling at Palm Valley-12 has been modelled with an approximate well centre of 269,430.00 m E and 7,344,070.00 m S (coordinate system in GDA 94 MGA, zone 53K)
- The representative SWL presented in Table 5-51 D has been modelled at a height of 2.5 m above grade level
- In relation to well drilling, all storage tanks and trailers were not included in the noise model as the design of individual leases can vary from well to well, and these structures cannot be relied upon to attenuate noise levels beyond approximately 200 m of the lease boundary

5.4.3.4.4 Noise Modelling Results

Palm Valley-12 drilling noise level predictions at the sensitive receptors detailed in Table 5-49 have been undertaken for neutral and adverse weather conditions, with the results of these predictions presented in Table 5-52.

Table 5-52 Palm Valley-12 – Predicted Drilling Noise Levels – Neutral and Adverse Weather

Sensitive Receptor	Minimum assumed rating background noise level (dB(A))	Project specific assigned noise level – residential receptor, night-time (L _{Aeq} 15 minute dB(A))	Predicted Noise Level ((L _{Aeq} 15 minute dB(A))	
			Neutral Weather	Adverse Weather
Township of Hermannsburg	30	35	<10	10
Palm Valley camp sites within the Finke George National Park	30	35	<10	<10

The noise modelling results in Table 5-52 indicate that predicated noise levels from the drilling activities at the identified sensitive receptors are less than the assumed RBLs and the most stringent project specific assigned noise level (night-time noise level of 35 dB(A) L_{Aeq,15min}), would be readily achieved at both identified sensitive receptors during drilling at Palm Valley-12 under both neutral and adverse weather conditions.

As no unacceptable noise levels have been predicted, specific noise mitigation measures are not warranted.

³³ Derived from historical noise measurements and model assessments SLR has completed on various drilling and cementing rigs.

5.4.3.5 Visual Assessment

A visual assessment was completed to assess the impact of drilling activities on surrounding sensitive receptors, being the township of Hermannsburg to the northeast of Palm Valley-12, and Palm Valley camp sites within the Finke George National Park south of Palm Valley-12.

5.4.3.5.1 Landscape Features

The landscape in the area around Palm Valley-12 has bold sandstone plateaux, stony plateaux, tablelands & hills on sandstone, siltstone, quartzite & conglomerate (deeply weathered in places). There are strongly superimposed drainages with narrow gorges and joint-controlled tributaries that can feed into riverine channels. The relief can be up to 200m.

Key topographic features of the area include:

- Mount Hermannsburg 1.2 km north east of the Palm Valley Gas Field (PVGF)
- Finke Gorge National Park to the south of the PVGF and has overlapping boundaries with OL3; and
- Finke River to the east

5.4.3.5.2 Viewshed analysis

The assessment was completed using a desktop analysis to understand the landscape character types and features within the area, sensitive viewer groups and views. A viewshed analysis was used in ESRI ArcGIS software, which uses a digital elevation model to understand if there are affect views or visual amenity. Figure 5-44 shows the output of the viewshed analysis, which uses a 50m point above ground level at PV-12 to represent the mast. The analysis shows that the PV-12 mast is not visible from the Palm Valley camp site and that the mast is also not visible from the southern half of Hermannsburg, but is visible from the northern half of Hermannsburg.

Recently CP drilled Palm Valley-13 (PV-13) which commenced on 21/8/2018 and was completed on the 22/10/2018. Flaring during PV-13 was visible from Hermannsburg and most likely the Palm Valley Campground. From Hermannsburg the flare from 8km looked like a glow on the horizon. The intensity of the light was low and did not impact on the community's regular activities. It is expected that PV-12 will have the same visual impact from flaring as PV-13.

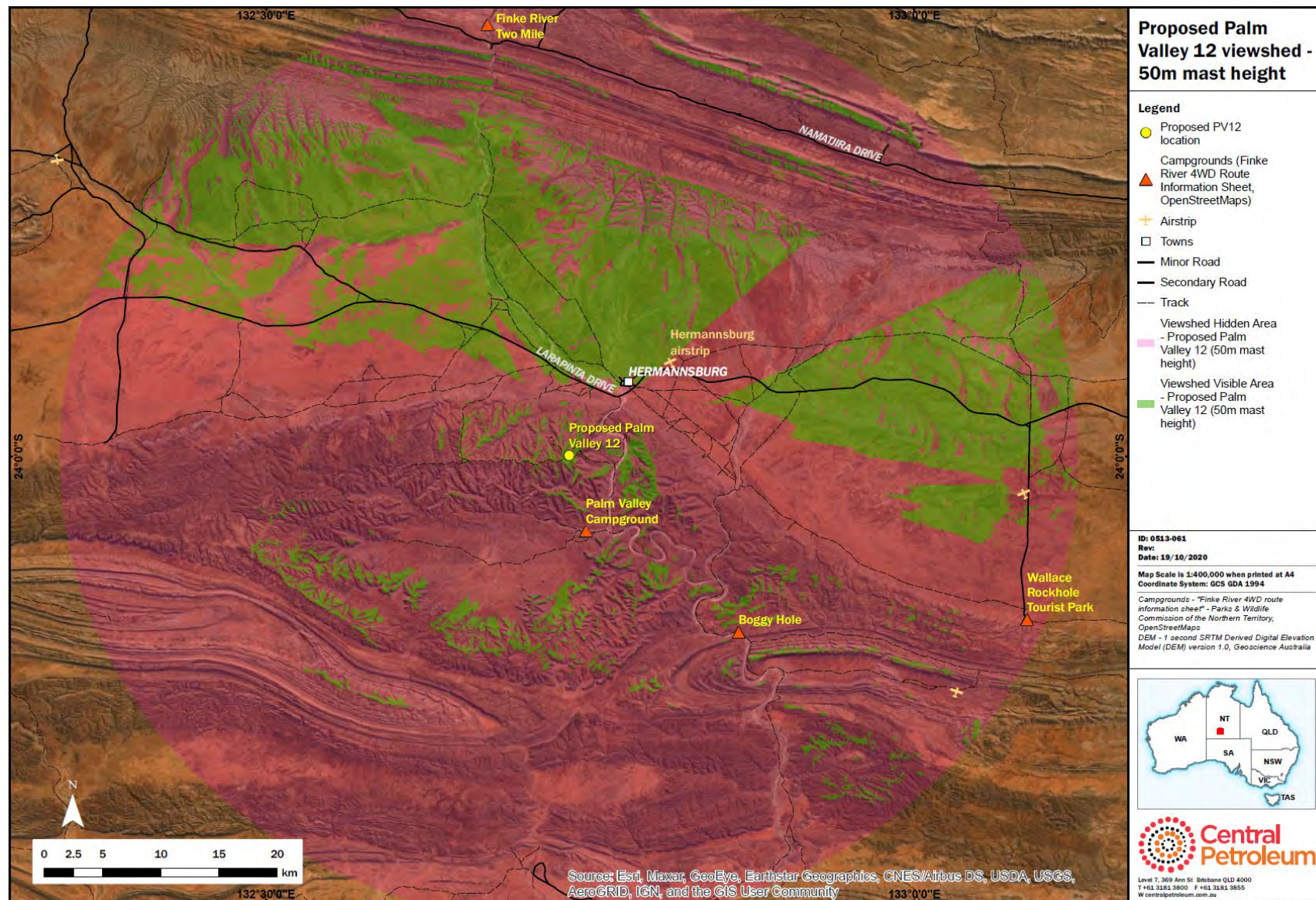


Figure 5-44 Palm Valley viewshed map

5.4.3.5.3 PV12 Drilling and Flaring Durations

Table 5-53 provides an overview of the duration of the drilling and flaring activities. CP will be undertaking drilling activities at PV12 for a total of 86 days. Flaring will only occur a couple times whilst drilling the well. The first flaring event will be when the rig intersects the Arumbera Formation, which it is expected to flare for approximately 4 days. Once evaluated the Arumbera section of the well will be isolated and flaring will cease. In well activities will then continue, with no flare, until the second section of the well is drilled and the Pacoota Formation is intersected horizontally. Flaring from the Pacoota Formation is expected to flare for approximately 16 days.

Table 5-53 PV12 Drilling and Flaring Durations

PV12	Drilling Activities	Flaring Activities
Palm Valley-12 (Arumbera)	86 days	4 days
Palm Valley-12 (Pacoota)		16 days

5.4.3.5.4 PV 12 Visual Impact Risk Assessment

The risks associated visual amenity is covered in the risk assessment component (Table 6-5) of the EMP. The key risk is listed as:

- Loss of Visual Amenity

Control measures to minimise local community complaints and disruption to the communities regular activities have been assessed as part of the risk assessment in Section 6.0 and this visual assessment. The controls include:

- Local community and Park Rangers alerted to flaring period by community engagement, provision of notices on public notice boards and notifications in the local paper
- PV is located 8km away from major roads and infrastructure is not easily visible from the major road
- Nearest homestead / Aboriginal Community is located approximately 8km (Palm Valley-12 location (Hermannsburg))

All risks associated with visual amenity have been assessed to a level that is ALARP and acceptable.

Table 8-8 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for community management

Any complaints from the community and received by CP will be managed through the Stakeholder Management Plans Assessment of Merit of Stakeholder Objection or Claim Section 11.7

5.4.3.6 Workforce

Workforce numbers for each activity during the drilling campaign are discussed in Section 4.2.

- Due to the short nature of the activity, local resourcing strategy and utilisation of onsite drill rig operator camps the overall impact of the project should be positive to the local community. This assessment is based on the following:
- All contractors and employees will operate under a Pandemic (COVID-19) Management Plan which ensures there will be no direct interactions with vulnerable remote communities, pre-arrival assessment and daily monitoring of workers health, etc
- There will be no impacts on the demographics of the regional population from the drilling campaign
- CP will prioritise local resourcing, there will be contracts available and employment opportunities for a positive effect on the local business and services

- Housing and accommodation impacts will be minimised as the drill rig operator mobilises onsite camps for their own workforce. These camps are located away from communities and there will be no resulting adverse impacts.
- there will be a positive impact to lodging and services businesses in Alice Springs on crew change over days (expected 1 overnight in Alice Springs). Crew rotations will be managed to ensure that the services in Alice Springs are not overwhelmed and can continue to accommodate for tourists.
- Crews flying / driving in and out of Alice Springs will be bussed to the camp to reduce light vehicle traffic on regional roads
- CP will also explore opportunities to provide education and training opportunities to promote the gas industry, integrate the NT gas story into the tourism experience and include STEM (science, technology, engineering and mathematics) learning into local schools with technical experts and guided field trips to CP operations.

5.4.3.7 Cultural Heritage

5.4.3.7.1 Historic and Natural Heritage

The Palm Valley-12 well is located within the MacDonnell Shire. An online search of the NT heritage register showed 18 publicly listed heritage sites in the MacDonnell Shire, none of which are located in the within the Palm Valley-12 well clearance area. No non-public sites were found by the online search.

EPBC PMST report for the Palm Valley-12 well did not identify any World Heritage Properties, National Heritage Places, Commonwealth Heritage Places or Places on the Register of National Estate within or within a 50km buffer of the Palm Valley-12 well clearance area (refer Appendix 2).

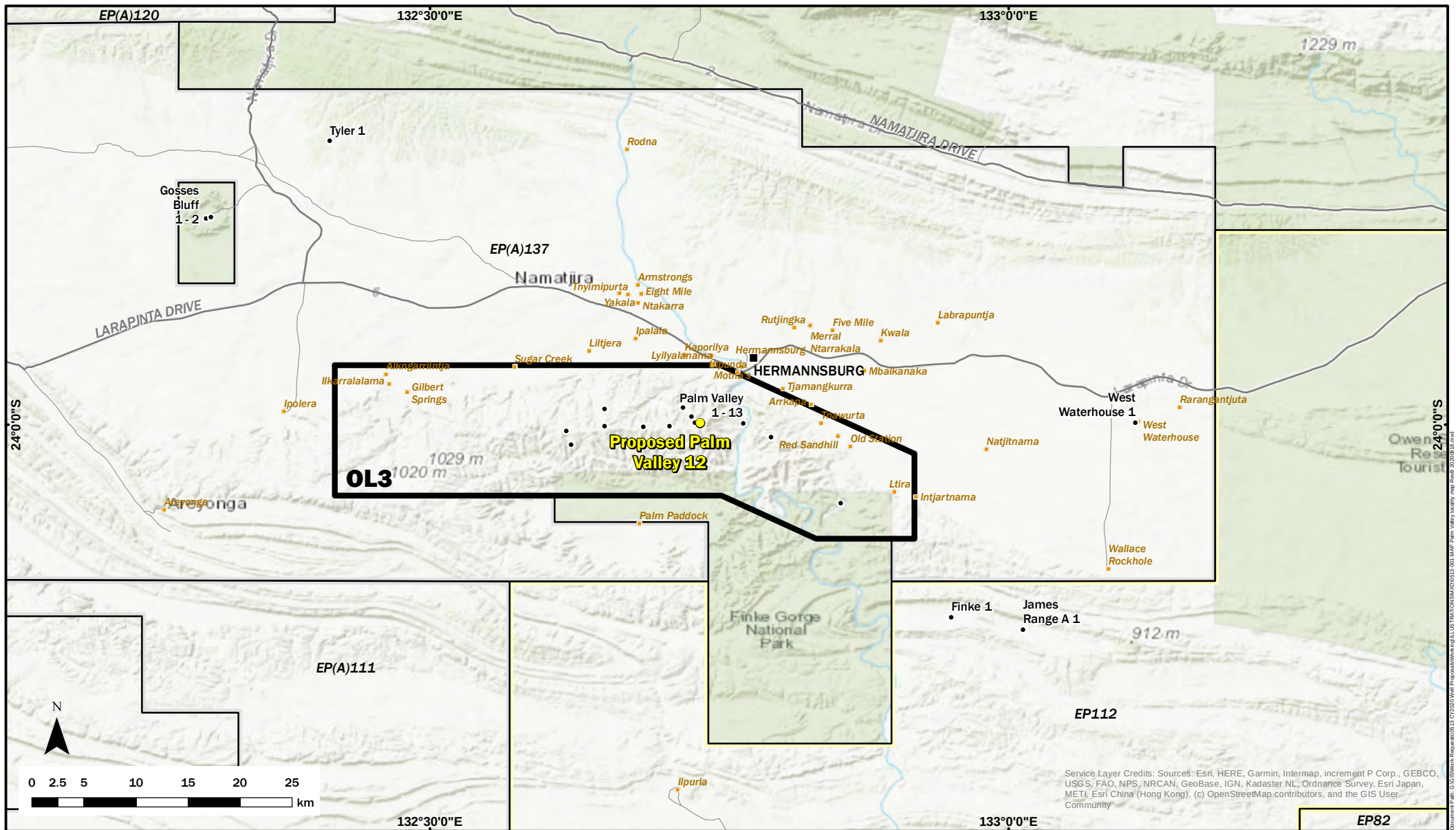
5.4.3.7.2 Aboriginal Archaeological Assessment

An Aboriginal archaeological assessment of the Palm Valley-12 well clearance area was undertaken by Everick Heritage in February 2020 to assess the potential impact of the drilling program on declared heritage places (i.e. all Aboriginal archaeological places) protected under the *Heritage Act 2011* (refer Appendix 3). During the assessment, four finds were made within the clearance area, with at least three finds being within the proposed disturbance footprint. CP is applying for a works approval under the *Heritage Act 2011* to lawfully relocate the finds outside of the disturbance footprint.

The Everick Heritage report includes an Aboriginal Objects Find / Stop Work Procedure which CP will implement at the Palm Valley-12 well.

5.4.3.7.3 Aboriginal Sacred Sites

In accordance with the *Aboriginal Sacred Sites Act 1989*, CP has received an Authority Certificate from AAPA for the Palm Valley-12 well (Certificate # C2020/061). CP commits to complying with the requirements of the granted Authority Certificate. Additionally, CP will also obtain a Sacred Site Clearance Certificate from the Central Land Council for the Palm Valley-12 well.



ID: 0513-001-MAP
Rev: B
Date: 18/08/2020

Map Scale is 1:500,000 when printed at A4
Coordinate System: GCS GDA 1994

Source:
Aboriginal Communities - Department of
Infrastructure, Planning and Logistics 2020

Figure 5-45 Palm Valley locality map

● Proposed Palm Valley 12	■ Aboriginal Communities	— Principal Road
■ Towns	▭ OL3	— Secondary Road
✈ Airport	— Railway	▭ CTP Permit Application
• Petroleum Wells	— Minor Road	▭ CTP Granted Permit



5.5 Mamlambo-1

5.5.1 Physical Environment

5.5.1.1 Climate

The Mamlambo-1 well clearance area experiences an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable.

Climate data has been summarised using all available data from the nearest Bureau of Meteorology weather station to the well (015664, Walungurru) and Table 5-54 shows the mean maximum and minimum temperature, mean rainfall, highest rainfall, lowest rainfall, mean days of rain and mean evaporation for each month.

Table 5-54 Climate Data (Mamlambo-1 Well)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	39.6	39.0	36.9	33.2	27.5	23.3	23.9	26.6	31.8	36.2	37.8	38.7
Mean minimum temperature (°C)	26.2	26.0	24.6	20.7	15.4	11.1	10.6	12.3	16.7	21.2	23.4	25.0
Mean rainfall (mm)	47.8	30.3	39.5	13.5	17.4	9.1	12.1	4.4	7.3	15.8	20.7	59.0
Highest rainfall (mm)	179.2	116.8	252.0	126.8	136.0	40.2	70.0	29.0	103.4	85.8	51.2	425.4
Lowest rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean days of rain	7.3	4.2	4.4	1.7	2.3	1.7	1.7	0.9	1.2	2.1	4.7	6.7
Mean evaporation (mm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

5.5.1.2 Regional Geology

The proposed Mamlambo-1 well is located within the Amadeus Basin, an east-west trending sedimentary basin extending across the southern part of the Northern Territory and into Western Australia. This basin covers an area of approximately 170,000 km² and a maximum sediment thickness of 14 000m with several major depocentres including the Idirriki, Carmichael and Ooraminna Sub-basins and Missionary Plain Trough along the northern margin and the Mount Currie and Seymour Sub-basins in the south (Geoscience Australia, 2020). It is bound in the north by the Arunta complex and in the south by the MusgraveMann complex, both containing granite, gneiss and schists, with amphibolite and quartzite.

The stratigraphy of the region is shown in Figure 5-1.

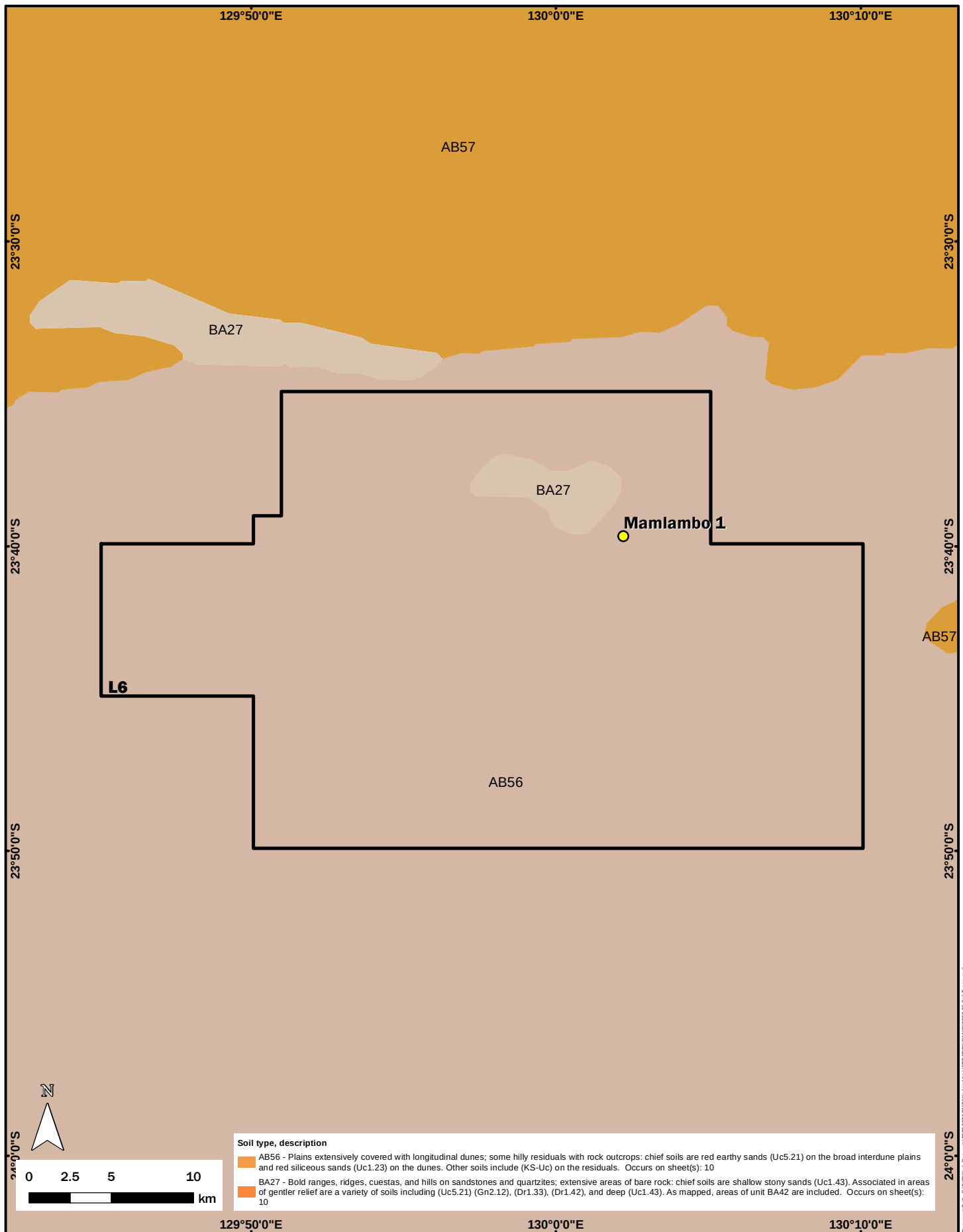
5.5.1.3 Regional Soils

Two soil types, as mapped using data from the Digital Atlas of Australian Soils (based on Northcote, et al., 1960-1968) are present within the wider Surprise field. Table 5-55 provides a description of these soil types with Figure 5-2Figure 5-46 Soil Types (Mamlambo-1 Well) showing the location of the Mamlambo-1 well relative to the soil types.

The Mamlambo-1 well is located within the AB56 soil type.

Table 5-55 Description of soils units (Mamlambo-1 Well)

Soil Type	Landform	Soils
AB56	Plains covered with longitudinal dunes, some hilly residuals with rock outcrops	Chief soils are red earthy sands on interdune plains and red siliceous sands on dunes
BA27	Bold ranges, ridges, cuestas, and hills on sandstones and quartzites. Extensive areas of bare rock	Chief soils are shallow stony sands



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Rev:
Date: 1/06/2020
Map Scale is 1:304,810 when printed at A4
Coordinate System: GCS GDA 1994
Digital Atlas of Australian Soils - 1991

Figure 5-46 Soil Units (Mamlambo 1 Well)

- Indicative well location
- Permit



5.5.1.4 Land Systems

A land system is an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1968). Land system descriptions provide a general and consistent basis for determining potential habitat types present within the region of the survey areas. Land system mapping available for the Mamlambo-1 well is at a scale of 1:1,000,000 (Perry et al. 1962).

The Mamlambo-1 well is located within the Simpson land system as shown in Figure 5-47 and described in Table 5-56.

Table 5-56 Land System (Mamlambo-1 Well)

Land System	Landform Class	Description
Simpson	Desert dunefields	Spinifex-covered sand dunes. Dunefields with parallel linear dunes, reticulate dunes and irregular or aligned short dunes. Variable relief. Associated swales in between dunes. Red sands on dunes and a variety of soil types in swales- such as red clayey sands, red earths and calcareous earths.

5.5.1.5 Land Types

Land types build upon the land systems described in Section 5.5.1.4 and are a mapping unit that delineate areas of similar landform, soils and vegetation to a reasonable level of detail and accuracy. Land types within the Mamlambo-1 well clearance area have been mapped at a scale of 1:5000 and is based on a survey conducted during February 2020.

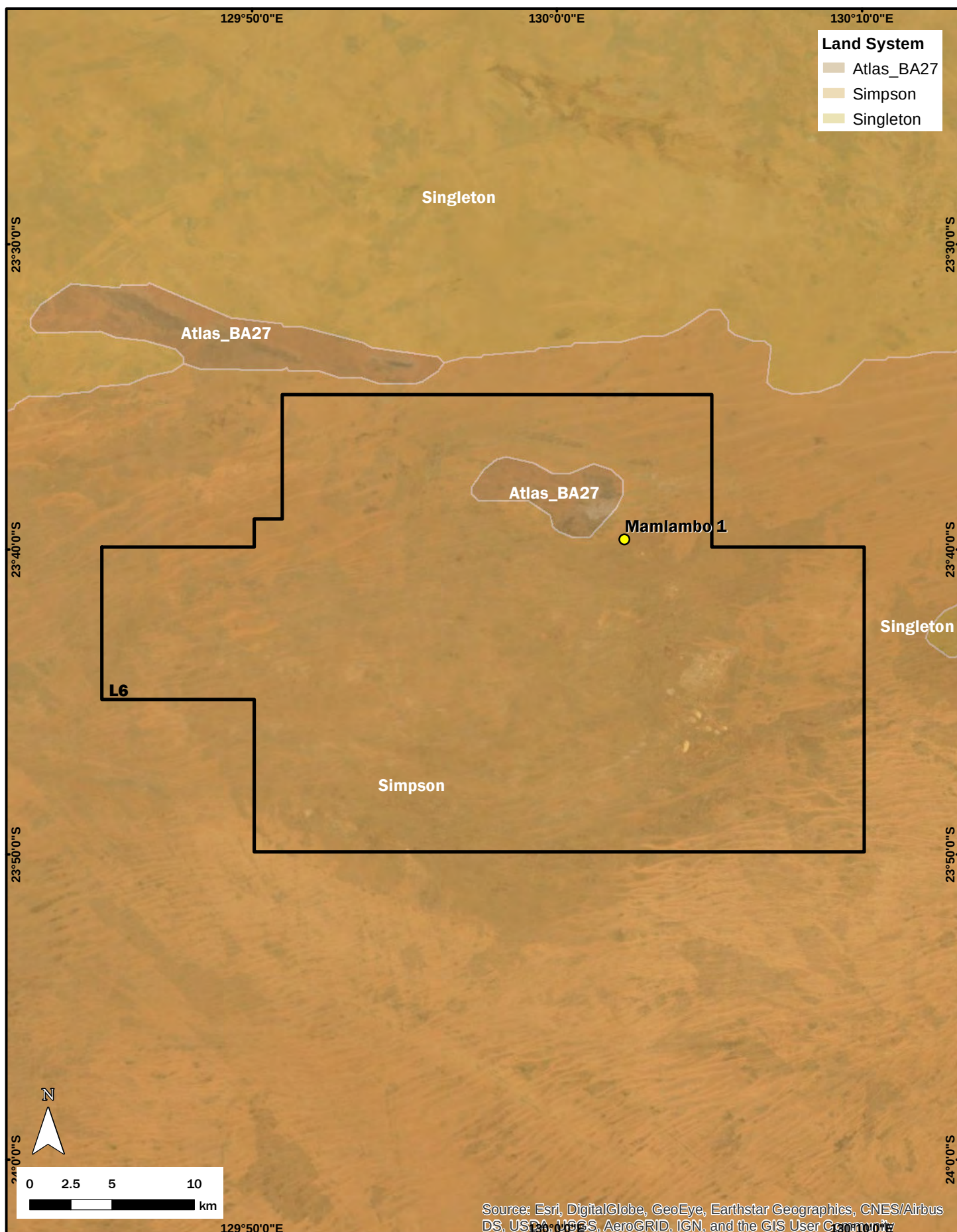
Six land types were identified within the Mamlambo-1 well clearance area as described in Table 5-57 and shown in Figure 5-48.

Table 5-57 Land Types (Mamlambo-1 Well)

Land type	Description	Photograph
M1-A	Flat to gently undulating sandplain. Red siliceous sands; occasional spots of exposed calcrete outcrop and calcareous fragments. Open shrubland dominated by <i>Eucalyptus gamophylla</i>, <i>Acacia ligulata</i>, <i>Acacia abrupta</i> and <i>Acacia melleodora</i> over spinifex (<i>Triodia epactia</i> and to a lesser extent <i>Triodia schinzii</i>). <i>Templetonia egena</i> and <i>Ptilotus obovatus</i> were also scattered across this unit. The eastern and southern parts of the site supported notably higher densities of <i>Acacia abrupta</i>. <i>Eucalyptus gamophylla</i> and <i>Acacia melleodora</i> also 'thickened up' in some areas (mainly in the western portion). Recently burnt areas (present along the access track) supported early recruit grass species including <i>Aristida holathera</i>, <i>Paspalidium reflexum</i> and <i>Yakirra australiensis</i> var. <i>australiensis</i>. Very little other recovery was noted due to low rainfall.	 

Land type	Description	Photograph
M1-B	Sandy red earth depressions; flat; localised. Sandy red earth; earthy clays. Open woodland of <i>Acacia ayersiana</i> and <i>Acacia estrophiolata</i> over open spinifex (<i>Triodia epactia</i>), tussock grasses (mainly <i>Eragrostis eriopoda</i> / <i>laniflora</i>) and <i>Ptilotus obovatus</i>. Likely higher cover of tussock grasses in better conditions. Other scattered trees and shrubs (likely associated with bird dispersal) include <i>Senna artemisioides</i> subsp. <i>petiolaris</i>, <i>Acacia pruinocarpa</i>, <i>Psyrax ammophila</i>, <i>Eremophila latrobei</i> subsp. <i>latrobei</i>, <i>Anthobolus leptomerioides</i>, <i>Stylobasium spathulatum</i>.	
M1-C	Low linear sand dunes (relief approx. to 5m). Red siliceous sands. Open shrubland of <i>Eucalyptus gamophylla</i> and <i>Acacia ligulata</i> with scattered <i>Grevillea stenobotrya</i>, <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> and <i>Acacia melleodora</i> over spinifex (<i>Triodia schinzii</i> and <i>Triodia epactia</i>). Other less common dune species included <i>Chrysocephalum eremaeum</i>, <i>Eriachne helmsii</i> and <i>Calytrix carinata</i>. Recently burnt areas (only encountered along access track) supported some early recruitment / germination of <i>Paractaenum refractum</i>, <i>Eriachne aristidea</i>, <i>Crotalaria cunninghamii</i> and <i>Tribulopsis angustifolia</i>; however, very little recovery of other dominant species (such as spinifex and shrubs) had occurred due to low rainfall.	 
M1-D	Stand of Desert Oak within sandplain. Sandy red earth soils. Open woodland of <i>Allocasuarina decaisneana</i> over scattered spinifex (<i>Triodia epactia</i>) and <i>Ptilotus obovatus</i>. Very low groundcover under canopy. Sparse low shrubland of <i>Eremophila latrobei</i> subsp. <i>latrobei</i>, <i>Eremophila platythamnus</i> subsp. <i>exotrachys</i> and <i>Acacia ligulata</i>. Desert Oak are scattered throughout several other land types but rarely present as mature trees.	

Land type	Description	Photograph
M1-E	Low calcrete rise. Calcareous earths; calcrete outcrop / fragments. Only present along access track. Low open shrubland of <i>Acacia kempeana</i> and <i>Senna artemisioides subsp. petiolaris</i> over <i>Aristida holathera</i>. Spinifex is the dominant groundcover; but was absent due to recent fire (could see remnants of burnt spinifex rings). Entirely burnt from recent fire in 2019. Therefore vegetation difficult to confidently describe.	
M1-F	Calcareous earth. Run-on area associated with calcrete rises. Only present along access track; avoided fire. Low open shrubland of <i>Senna artemisioides subsp. petiolaris</i> over a sparse ground later of <i>Ptilotus obovatus</i> and spinifex (<i>Triodia epactia</i>). Other less common species included <i>Templetonia egena</i>, <i>Ptilotus sessilifolius</i>, <i>Sclerolaena diacantha</i>, <i>Eremophea spinosa</i>, <i>Eragrostis sp. Limestone</i>, <i>Eremophila sturtii</i>, <i>Eragrostis eriopoda</i>.	



ID: 0523-04
Rev:
Date: 1/06/2020
Map Scale is 1:304,810 when printed at A4
Coordinate System: GCS GDA 1994
Land Systems - Department of Environment and Natural Resources

Figure 5-47 Land Systems (Mamlambo 1 Well)

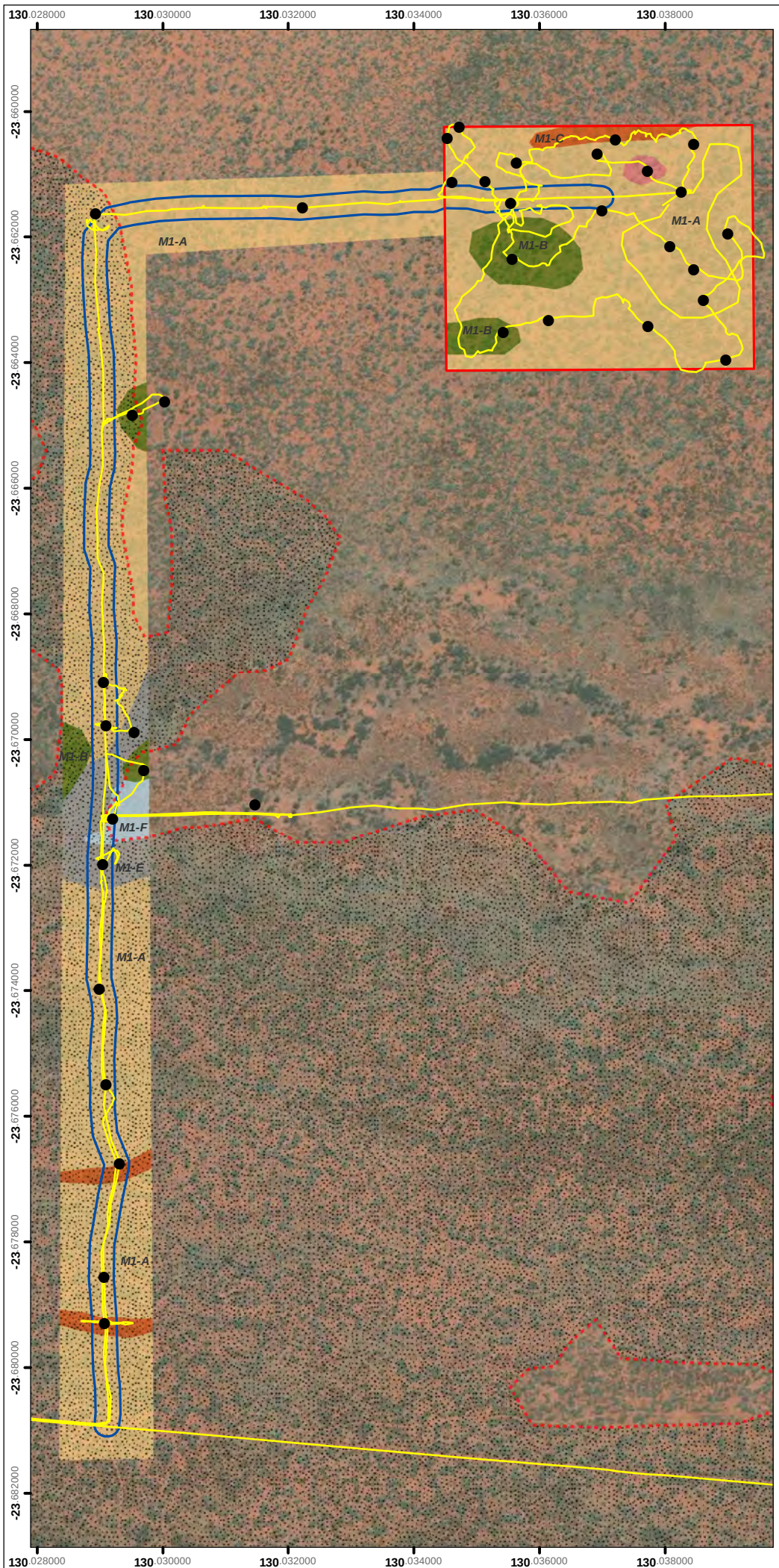
Indicative well location

Permit



Level 7, 369 Ann St Brisbane QLD 4000
T +61 3181 3800 F +61 3181 3855
W centralpetroleum.com.au





MAMLAMBO 1

Survey area

- Proposed access survey area
- Drill site clearance area
- ⋯ Recent fire scar (Nov 2019)
- Check sites
- Survey transects

Land types (1:5,000) (ground-truthed)

M1-A: Sandplain with an open shrubland dominated by *Eucalyptus gamophylla*, *Acacia ligulata*, *Acacia abrupta* and *Acacia melleodora* over *spinifex* (*Triodia epactia* and to a lesser extent *Triodia schinzii*).

M1-B: Sandy red earth depression with an open woodland of *Acacia ayersiana* and *Acacia estrophiolata* over open *spinifex* (*Triodia epactia*), tussock grasses (mainly *Eragrostis eriopoda* / *laniflora*) and *Ptilotus obovatus*.

M1-C: Sand dune with an open shrubland of *Eucalyptus gamophylla* and *Acacia ligulata* with scattered *Grevillea stenobotrya*, *Dodonaea viscosa* subsp. *angustissima* and *Acacia melleodora* over *spinifex* (*Triodia schinzii* and *Triodia epactia*).

M1-D: Sandy red earth with Open woodland of Desert Oak (*Allocasuarina decaisneana*) over *spinifex* (*Triodia epactia*) and *Ptilotus obovatus*. Sparse shrubs.

M1-E: Low calccrete rise (recently burnt) with a low open shrubland of *Acacia kempeana* and *Senna artemisioides* subsp. *petiolaris* over *spinifex*.

M1-F: Calcareous plain with a low open shrubland of *Senna artemisioides* subsp. *petiolaris* over a sparse ground later of *Ptilotus obovatus* and *spinifex* (*Triodia epactia*).



0 50 100 200
Metres



MAP INFORMATION

Scale: 1:10,000 @ A4
Projection: GCS GDA 1994
Date Saved: 27/04/2020
Client: Enviro-Value
Author / Mapper: TR

DATA SOURCE

Survey area: Central Petroleum
Survey data: EcOz (Mar 2020)
Fire scar 2019: EcOz 2020
Imagery: Maxar (Aug 2018)

EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either expressed or implied.

Figure 5-48 Land types present within the Mamlambo 1 clearance area

5.5.1.6 Groundwater

The Mamlambo-1 well is located in the Amadeus Basin, an elongated east-west aligned sedimentary basin that covers an area of approximately 170 000 km² in central Australia. Lloyd and Jacobson (1987) define two main hydrogeological domains within the Amadeus Basin: the north-central area has broad folding associated with extensive and mappable sandstone formations, elsewhere in the basin greater deformation has resulted in the development of a regional fractured rock groundwater systems. Mamlambo is located in the far-west of the Amadeus Basin, nominally within the regional fractured rock domain of Lloyd and Jacobson (1987), though in an area where there is a noted paucity of hydrogeological data. Table 5-58 provides a summary of the formation depths, thickness and groundwater potential at the Mamlambo-1 well from the surface units down to the Goyder Formation.

Table 5-58 Summary Stratigraphy and Groundwater Occurrence (Mamlambo-1 Well)

Formation	Depth* (mBGL)	Thickness* (m)	Lithology	Groundwater Availability	Water Quality^	Considered an aquifer for well design purposes
Quaternary/Tertiary Sediments	Surficial	< 70	Dune sands, gypsum, calcrete	potential for local useable supplies available when sufficient saturated thickness exists	Fresh to saline	Yes
Brewer Conglomerate/ Hermannsburg Sandstone	< 70	200 - 270	Siltstone, claystone, minor sandstone	Poor	Not Known	No
Parkes Siltstone	270	400	Siltstone, minor claystone	Poor	Not Known	No
Mereenie Sandstone	670	240	Porous quartz sandstone	Good potential for useable groundwater supplies across the region	Brackish	Yes
Stokes Siltstone	910	150	Claystone, siltstone	Poor	Not Known	No
Stairway Sandstone	1060	120	Silty sandstone with interbedded siltstone	Oil Reservoir	Not known	No
Horn Valley Siltstone	1180	60	Claystone with interbedded marl and limestone	Poor	Not known	No
Pacoota Sandstone	1240	70	Quartz sandstone with minor claystone	Oil Reservoir	Not known	No
Goyder Formation	1310	-	Claystone with interbedded siltstone and minor sandstone	Poor	Not known	No

*Depths and thickness based on Mamlambo well design

^ Water quality assessment is based on bore data and the Mt Rennie Hydrogeological Map

Within the Amadeus Basin, the Mamlambo-1 well is situated in the Johnson Trough on the northern flank of the basin, approximately 8 km north-east of the Surprise 1 oil well. The surface geology of the immediate area is characterised by Quaternary dune sands, clay pans, gypsum and calcrete. Where sufficiently thick, these deposits can form local scale groundwater supply sources. The Mt Rennie Hydrogeological Map (Jamieson and Wischusen, 1998) categorises these deposits as having moderate bore yields (1 – 5 L/s) with fresh to saline water quality (typically brackish). Where calcrete is present there is a possibility of enhanced bore yields due to cavities. The recent sedimentary deposits overlie a thick sequence of Brewer Conglomerate and Hermannsburg Sandstone. Along with the underlying Parkes Siltstone these formations predominantly comprise claystone, siltstone and shale. They have poor groundwater availability and on the basis of lithology are likely to form an aquitard unit. The Hermannsburg Sandstone, which is productive in other regions of the Amadeus Basin is locally described as comprising fine grained siltstone (Central Petroleum, 2010a) with very poor porosity (Central Petroleum, 2010b). The Hermannsburg Sandstone it is not considered likely to form a significant water source at this location. No groundwater bores are constructed in the Brewer Conglomerate/Hermannsburg Sandstone/Parkes Siltstone within the lease area.

The Mereenie Sandstone comprises loose, fine to very coarse grained quartz sandstone with visible porosity (Central Petroleum, 2010a). Relative to the eastern Amadeus Basin there is limited hydrogeological data available on the Mereenie Sandstone but it is presumed to have good potential for groundwater supplies on a regional scale. Jamieson and Wischusen (1998) class the formation as having moderate bore yields (1 – 5 L/s) with a typically brackish water quality. Bore RN018463 drilled along strike of outcropping sandstone 2 km north-west of the Mamlambo-1 well lease is likely constructed in the Mereenie Sandstone. Bore RN018463 has a reported airlift yield of 15 L/s, a water quality of 6,150 µs/cm EC and a water level of 13.4 mBGL. There is insufficient bore data to establish local groundwater flow directions within the Mereenie Sandstone. On a regional scale, groundwater is expected to flow to the south toward the Lake Amadeus/Lake Neale playa lakes, which form a regional scale groundwater discharge feature (Jacobson et al, 1989).

The Mamlambo-1 well targets potential oil reservoirs in the Pacoota Sandstone and the Lower Stairway Sandstone, the latter being the productive oil reservoir interval in the Surprise No. 1 well. The Stairway Sandstone reservoir is separated from groundwater resources in the Mereenie Sandstone by around 150 m of the Stokes Siltstone.

5.5.1.6.1 Groundwater Bores

A search of the groundwater bores on NR Maps³⁴ identified four bores within a 10 km radius of Mamlambo, of which two bores are within a 5 km radius (see Figure 5-50). All four registered bores are investigation bores drilled for CP under previous programs. Key details for each bore are summarised in Table 5-59.

The Mamlambo-1 drilling campaign is estimated to require roughly 1.4 ML of water (Table 4-4) and it is intended that the water will be supplied from RN018851. The Theis (1935) solution was used to estimate the drawdown, based on the civil works and drilling being carried out as a continuous activity, with the camp requirement being split over the entire duration (40 days). This analysis indicates that drawdown will be effectively unmeasurable beyond approximately 100m of the extraction bore (Figure 5-49).

³⁴ <https://nrmaps.nt.gov.au/nrmaps.html>

Table 5-59 Summary of Registered Bores (Mamlambo-1 Well)

Bore ID	Distance from Mamlambo-1 (km)	Formation [#]	Constructed Depth (mBGL)	Groundwater EC (µS/cm)	Groundwater Depth (mBGL)
RN018463	2.2	Mereenie Sandstone	79	6,150	13.4
RN018398	3	Cleland Sandstone ³⁵	58.5	8,000	8
RN018851	7.2	Quaternary (gravels)	60	1,530	16
RN018397	7.5	Quaternary (laterite)	71	1,250	9.5

Based on interpretation of driller's log and surface geology. The log for bore RN018398 is inconclusive.

Bore yields range from 0.7 – 2 L/s with the exception of RN018463 which yielded 15 L/s and is thought to screen the Mereenie Sandstone. The bore depth ranges from 60 – 116.5 m, depth to groundwater from 8 – 16 mBGL and water quality from 1,250 – 8,000 µS/cm EC.

Two relatively fresh-water qualities (1,250 µS/cm and 1,530 µS/cm) are reported for two bores (RN018397 and RN018851) constructed in the Quaternary deposits and suggest that these deposits are receiving rainfall recharge.

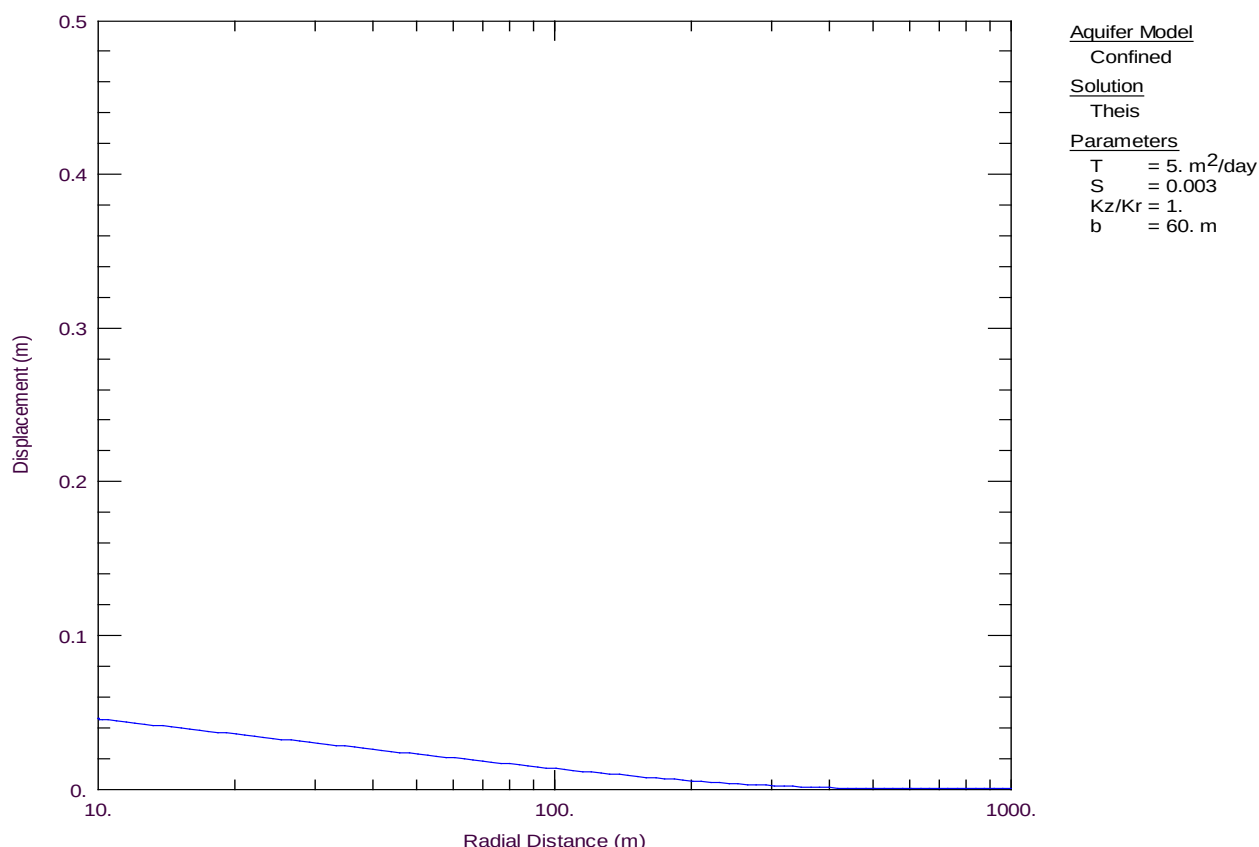


Figure 5-49 Distance-drawdown prediction for groundwater extraction associated Mamlambo-1 civil works, drilling and camp water supply

5.5.1.6.2 Baseline Bore Sampling

A baseline groundwater sample from bore RN018463, the closest bore to the Mamlambo-1 well lease pad, was collected in February, 2020. The sample was collected using low flow sampling methods, it was transported for analysis under standard chain of custody protocols to ALS laboratories in Brisbane. The

³⁵ Based on interpretation of the Mt Rennie 1:250k geological map (Close et al., 2004).

groundwater was analysed for physical chemistry, major ions, alkalinity, nutrients, silica, dissolved and total metals, dissolved hydrocarbon gases, PAH, TPH, TRH and BTEX.

A summary of water level, field parameters and laboratory results are presented in Appendix 2 alongside Australian drinking water guidelines (NHMRC, NRMCC 2011) and stock watering guidelines (ANZECC 2000), where applicable. The groundwater sample from RN018463 exceeds the drinking water palatability guideline for TDS and the health-based guideline for fluoride. The groundwater sample also shows minor detections of TPH (fraction C15-28) and TRH (fraction C16-34). All other analytes are below drinking water health related guidelines and stock water guidelines.

5.5.1.6.3 Wetlands, Springs and Groundwater Dependant Ecosystems

The Bureau of Meteorology GDE Atlas identifies several small aquatic GDEs (unclassified potential GDEs based on a national assessment) in the general vicinity of the site. The Geoscience Australia WoFS product displays the percentage of observations in which surface water was detected and is derived from satellite imagery from 1987 to the present day (GA, 2019). The WoFS observations provide an indication of surface water presence, with permanence an indication of groundwater discharge. The WoFS shows that there is no permanent surface water in the vicinity of the site. In those areas that the presence of surface water was observed, it was generally present in a low percentage of the images (<20%) and is associated with clay pans that receive surface water run-off from rainfall events.

The GDE Atlas does not identify any terrestrial GDEs in the vicinity of the Mamlambo-1 well lease, however given the shallow depth (<15m) of groundwater in the vicinity of the Mamlambo-1 well lease, it is likely that some of the larger woody vegetation (e.g. mature desert oaks) are accessing groundwater.

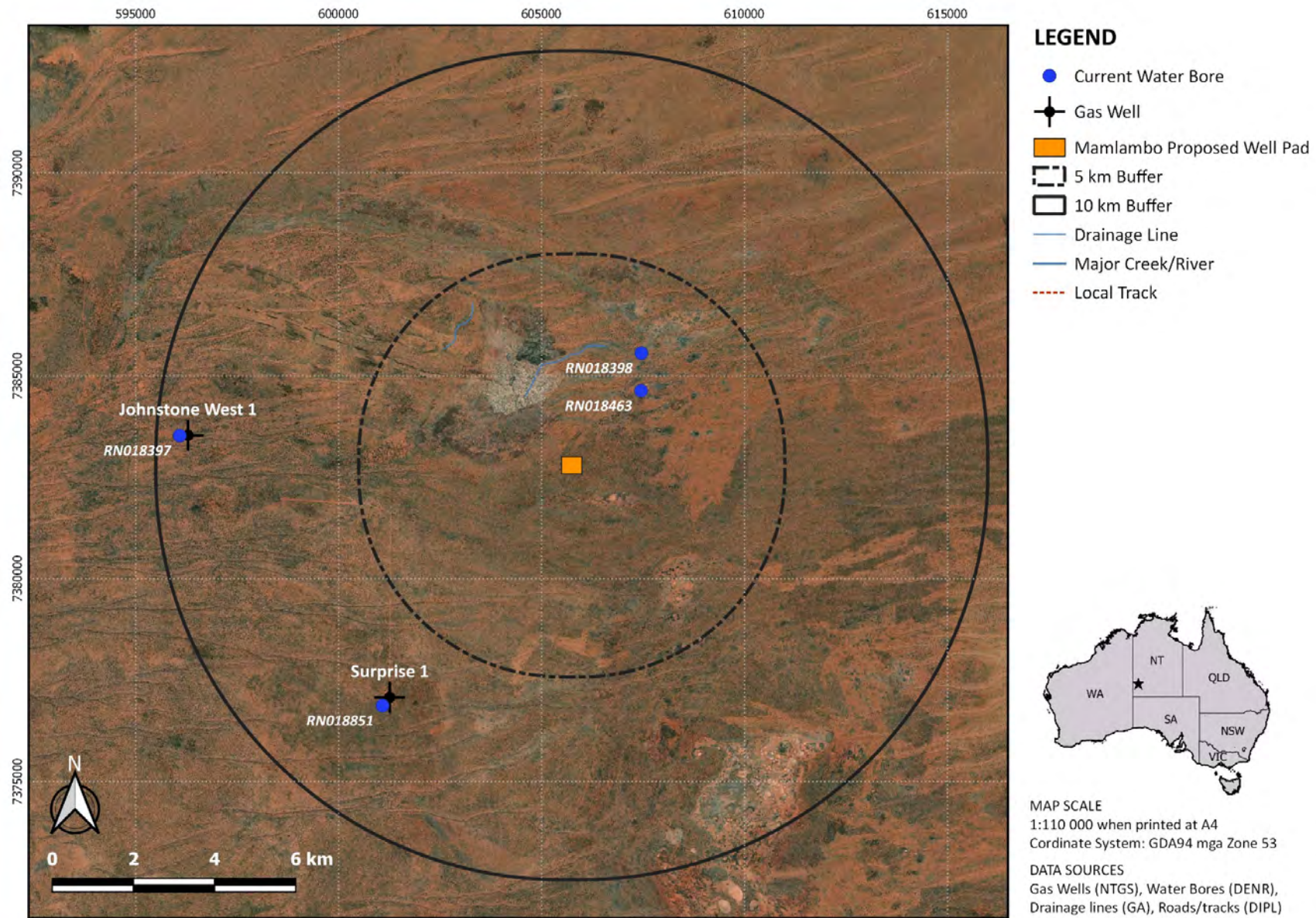
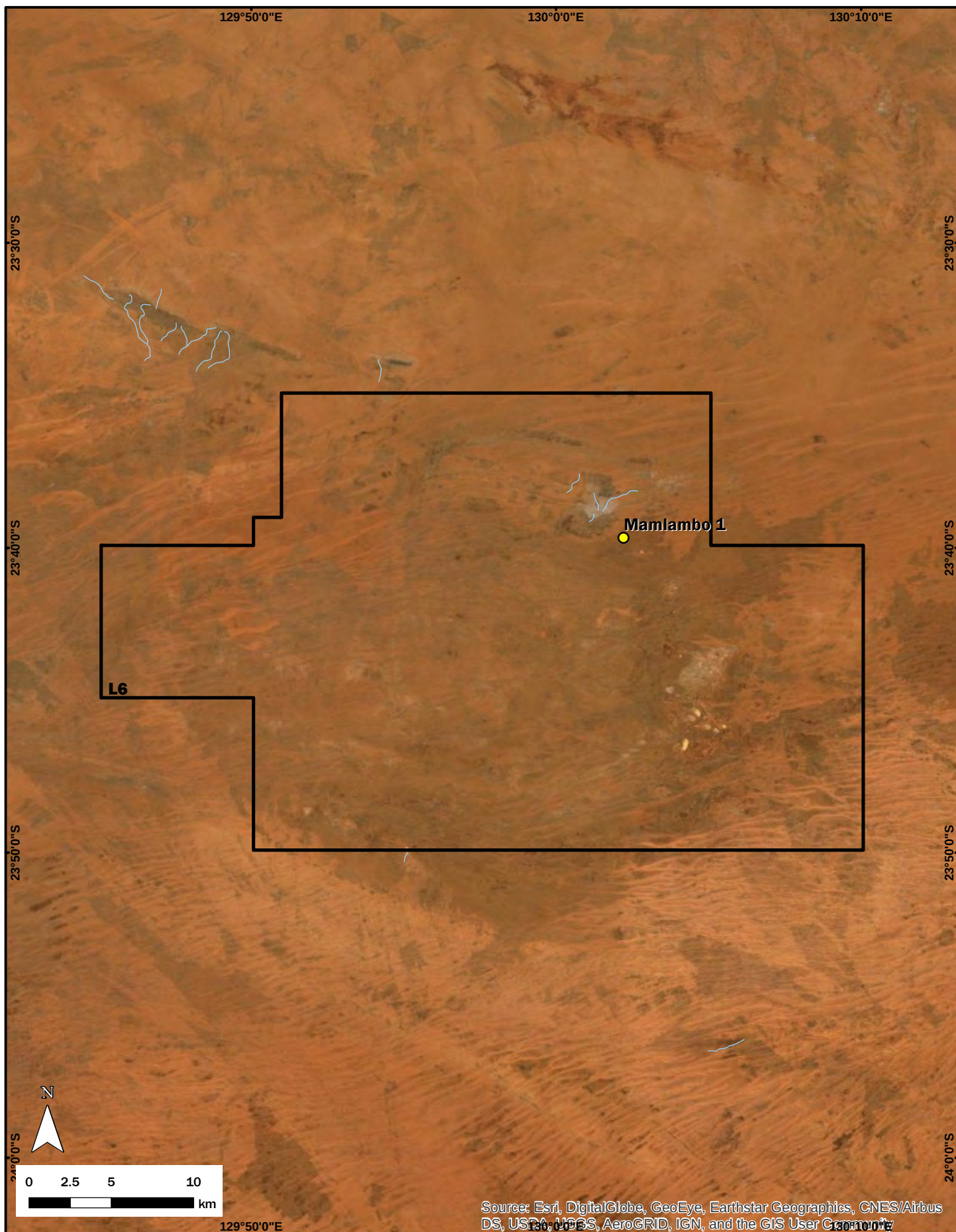


Figure 5-50 Registered Groundwater Bores within 10 km (Mamlambo-1 Well)

5.5.1.7 Surface Water

The Mamlambo-1 well is located within an expansive floodplain which conveys flows through to Lake MacDonald during flood events. Flood modelling of the proposed Mamlambo-1 well lease has been undertaken and the well lease is not located within the 1% AEP rainfall event (refer Appendix 1). As such, no flood mitigation works is required at this well lease

A map of the surface hydrology of the proposed Mamlambo-1 well site area is available in Figure 5-51. The buffer distance to stream orders from the disturbance areas is in line with the within the recommended widths specified in the DEPWS Land Clearing Guidelines (2019).



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ID: 0523-07
 Rev:
 Date: 1/06/2020
 Map Scale is 1:304,810 when printed at A4
 Coordinate System: GCS GDA 1994
 Northern Territory Mapped Streams - Department
 of Environment and Natural Resources

Figure 5-51 Surface hydrology (Mamlambo 1 Well)

- Indicative well location
- Permit
- Streams



5.5.2 Natural Environment

5.5.2.1 Bioregions

The Mamlambo-1 well clearance area is located within the Great Sandy Desert bioregion (refer Figure 5-52) as classified by (Baker, et al., 2005) and described in Table 5-60 .

Table 5-60 Bioregions (Mamlambo-1 Well)

Bioregion	Topography	Geology	Soils	Vegetation
Great Sandy Desert	The area is generally flat and arid with few watercourses, although there are several low ranges	Large expanse of horizontally bedded Mereenie Sandstone and associated Cambrian marine sediments – calcareous	Predominantly shallow sands and are influenced by the presence of saline lakes, where mostly saline loams occur	Dominated by hummock grassland with areas of tall-shrubland or low open woodland, Mulga tall open-shrubland and Samphire low open-shrubland fringing salt pans

5.5.2.2 Sites of Conservation Significance

There are currently 67 SOCS identified by the Northern Territory government. SOCS are areas defined by the Northern Territory government as important sites for biodiversity conservation that need further protecting.

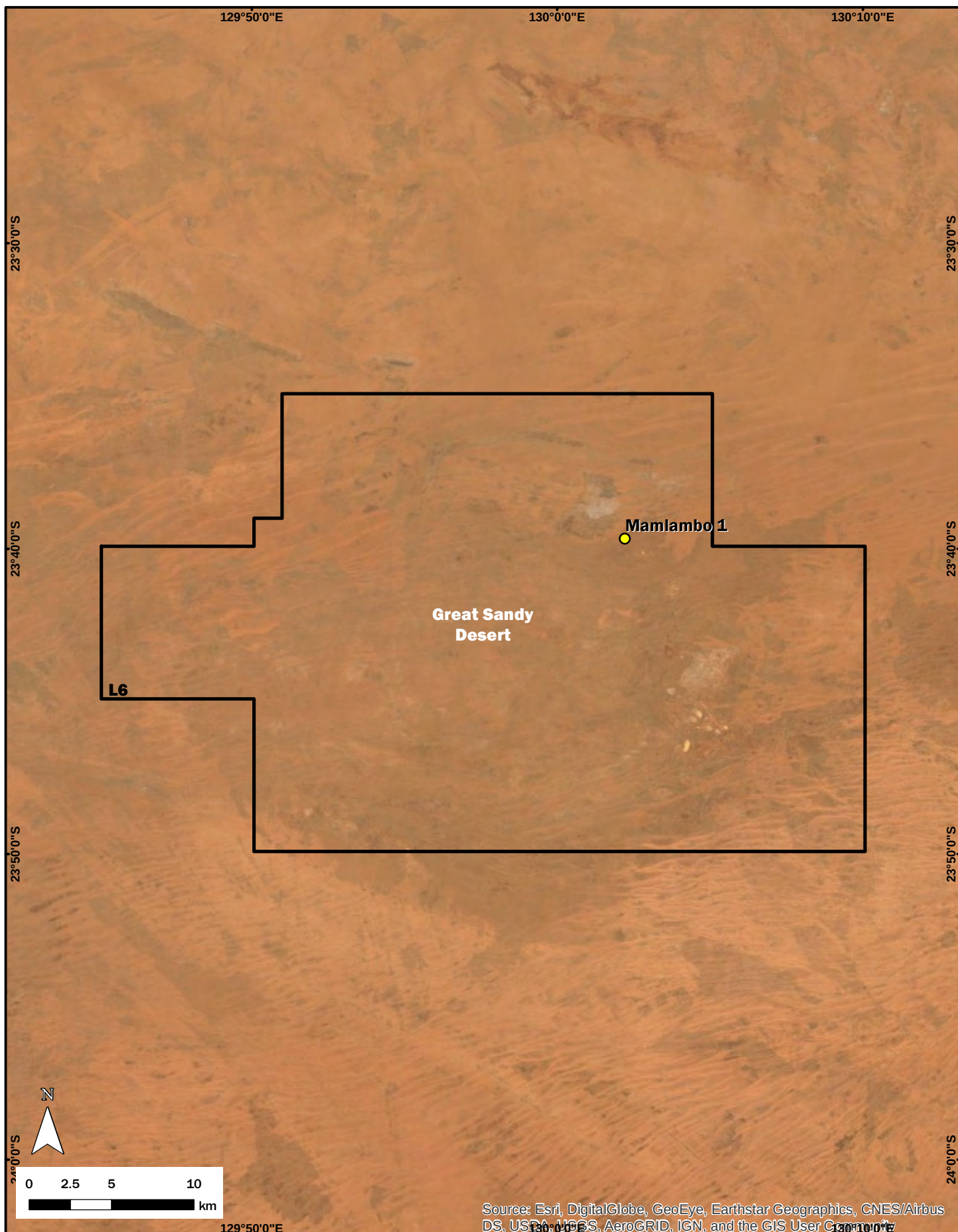
The closest SOCS to the Mamlambo-1 well clearance area is the Cleland Hills and Surrounds, located approximately 40 km to the east. Figure 5-53 provides an overview of the Mamlambo-1 well relative to the nearest SOCS.

5.5.2.3 Sites of Botanical Significance

A SOBS is an area that has been defined (by White et al. 2000) to hold important and / or unique botanical assemblages that require protection. SOBS are designated as either nationally significant (41 sites), bioregionally significant (79 sites) or of undetermined significance (33 sites).

Currently there is no specific legislation attached to SOBS, although protection of the SOBS is administered through other pieces of legislation (e.g TPWC Act etc)

The Mamlambo-1 well clearance area is not located within a SOBS.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ID: 0523-02

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Date: 1/06/2020

Map Scale is 1:304,810 when printed at A4
Coordinate System: GCS GDA 1994

Interim Biogeographic Regionalisation for Australia
(IBRA) version 7.0 - Australian Government
Department of Sustainability, Environment, Water,
Population and Communities

Figure 5-52 Bioregions (Mamlambo 1 Well)

● Indicative well location

IBRA region

Great Sandy Desert

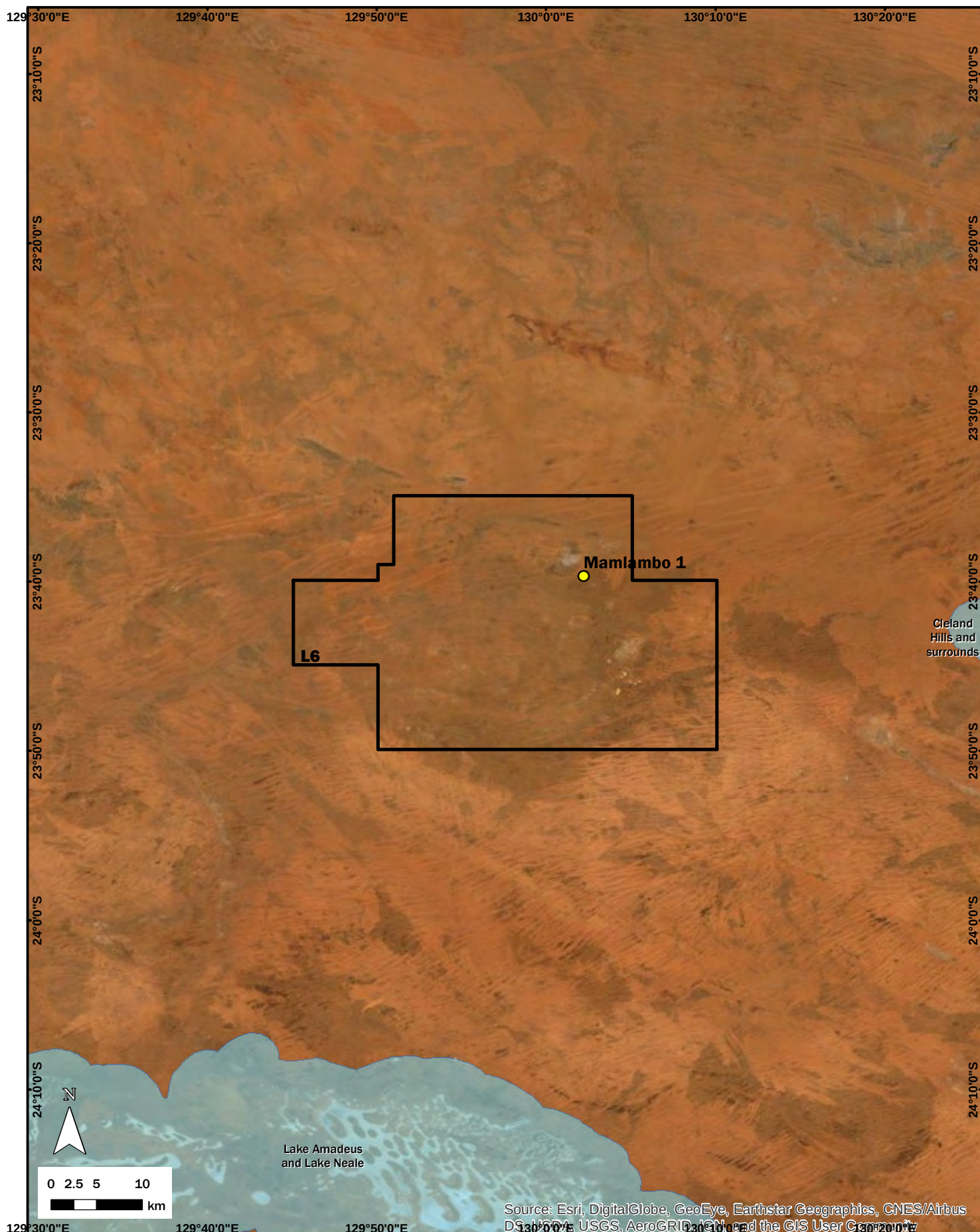
Permit



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ID: 0523-03

Rev:

Date: 1/06/2020

Map Scale is 1:550,000 when printed at A4
Coordinate System: GCS GDA 1994

Sites of Conservation Significance from
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Figure 5-53 SOCS (Mamlambo 1 Well)

● Indicative well location

□ Permit

Sites of Conservation Significance

□ National



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5.5.2.4 Threatened Ecological Communities

No threatened ecological communities were identified within the proposed Mamlambo-1 well clearance area.

5.5.2.5 Conservation Significant Flora

A flora species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Flora Atlas within the sub-bioregion of the Mamlambo-1 well clearance area or
 - has been recorded during an ecological assessment of the Mamlambo-1 well clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Mamlambo-1 well clearance area or
 - has been recorded during field surveys of the Mamlambo-1 well clearance area.

Based on the results of desktop searches, previous field survey (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Mamlambo-1 well clearance area, Table 5-61 provides a summary of flora species of conservation significance which may be present within the Mamlambo-1 well clearance area and identifies the likelihood of each species occurring based on ground truthing within that clearance area.

One DD species under the TPWC Act were detected during the ecological assessment, being:

- *Acacia incurvaneura* - A single juvenile on sandplain near dune north in northern part of drill site survey area. Species was incidentally observed in several other locations outside of the survey area, and likely has a scattered occurrence throughout the region.

In addition to the conservation significant flora detected during the ecological assessment an additional ninety-five flora species were detected within the Mamlambo-1 well clearance area, of which:

- One was an introduced species (*Cenchrus ciliaris*)
- One species is listed as not evaluated under the TPWC Act - *Evolvulus alsinoides* var. *alsinoides*. A widespread and common species, listed as not evaluated due to recent taxonomic changes not yet been subject to TPWC Act criteria
- Remaining species are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

Table 5-61 Conservation Significant Flora (Mamlambo-1 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	Flora Atlas Records	Survey Result	Likelihood of Occurrence ³⁶
<i>Acacia incurvaneura</i>	Narrow-leaf Mulga	DD	-	-	-	Yes ³⁷	Likely
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	VU	VU	-	2	No	Unlikely
<i>Santalum acuminatum</i>	Desert Quandong, Native Peach	VU	-	-	7	No	Unlikely

³⁶ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

³⁷ Single juvenile species located to the north of the proposed well lease area

5.5.2.6 Conservation Significant Fauna

A fauna species is considered in this EMP to be of conservation significance if it is:

- Listed as EW, CR, EN, VU, NT or DD under the TPWC Act and has been either:
 - recorded in the Northern Territory Fauna Atlas within the sub-bioregion of the Mamlambo-1 well clearance area or
 - has been recorded during an ecological assessment of the Mamlambo-1 well clearance area or
- Listed as CR, EN, VU or CD under the EPBC Act and is either:
 - identified by a PMST report within 50 km of the Mamlambo-1 well clearance area or
 - has been recorded during an ecological assessment of the Mamlambo-1 well clearance area.

Based on the results of desktop searches, previous ecological assessment (refer Appendix 2) and the PMST Report (refer Appendix 2) for the Mamlambo-1 well clearance area, Table 5-62 provides a summary of fauna species of conservation significance which may be present within the Mamlambo-1 well clearance area and identifies the likelihood of each species occurring based on ground truthing within the Mamlambo-1 well clearance area.

Whilst no conservation significant fauna were detected during the baseline ecological assessment, performed in February 2020, twenty-five fauna species within the Mamlambo-1 well clearance area were detected of which:

- Ten birds, eleven reptiles and four mammal species
- All species are listed under the TPWC Act as Least Concern. Refer to Appendix 2 for the full listing of these species.

In addition, key habitat features within the survey area were identified - namely sandy red earth plains and rises, a low sandstone hill (approximate 10m relief), a flat gravelly (laterised) plain, and a low dune. The survey in Appendix 2 indicates that the area is unlikely to support threatened species, which includes the Southern Marsipual Mole, Greater Bilby, Brush-tailed Mulgra, Grey Falcon and Princess Parrot.

Table 5-62 Conservation Significant Fauna (Mamlambo-1 Well)

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	NT Atlas Records	Survey Result	Likelihood of Occurrence ³⁸
<i>Calidris ferruginea</i>	Curlew Sandpiper	VU	CR	-	1	No	Unlikely
<i>Calidris tenuirostris</i>	Great Knot	VU	CR	-	1	No	Unlikely
<i>Falco hypoleucos</i>	Grey Falcon	VU	-	-	52	No	Unlikely
<i>Leipoa ocellata</i>	Malleefowl	CR	VU	-	7	No	Unlikely
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	May occur	2	No	Unlikely
<i>Polytelis alexandrae</i>	Princess Parrot	VU	VU	Likely to occur	89	No	Unlikely
<i>Liopholis kintorei</i>	Great Desert Skink	VU	VU	May occur	81	No	Unlikely
<i>Liopholis slateri</i>	Slater's Skink	VU	EN	-	1	No	Unlikely

³⁸ Likelihood of occurring based on the baseline field surveys undertaken in the ecological report in Appendix 2

Scientific Name	Common Name	TPWC Status	EPBC Status	EPBC Presence	NT Atlas Records	Survey Result	Likelihood of Occurrence ³⁸
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	VU	VU	-	423	No	Unlikely
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	VU	EN	-	4	No	Unlikely
<i>Isoodon auratus</i>	Golden Bandicoot	EN	VU	-	16	No	Unlikely
<i>Lagorchestes hirsutus</i>	Mala	EW	CR	Likely to occur	12	No	Unlikely
<i>Macroderma gigas</i>	Ghost Bat	NT	VU	-	5	No	Unlikely
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU	May occur	213	No	Unlikely
<i>Notoryctes typhlops</i>	Southern Marsupial Mole	VU	-	-	92	No	Unlikely
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby	NT	VU	May occur	62	No	Unlikely
<i>Rattus tunneyi</i>	Pale Field-rat	VU	-	-	1	No	Unlikely
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	VU	-		2	No	Unlikely
<i>Trichosurus vulpecula</i>	Common Brushtail Possum (central)	EN	-	-	34	No	Unlikely
<i>Zyomys pedunculatus</i>	Central Rock-rat	EN	CR	-	3	No	Unlikely
<i>Semotrachia euzyga</i>	a land snail	EN	EN	-	2	No	Unlikely
<i>Granulomelon squamulosum</i>	a land snail	VU	-	-	1	No	Unlikely

5.5.2.7 Weeds

Weeds managed under this EMP can be categorised via the following methods:

- WoNS – nationally agreed priority flora species for control and management. Weed species are determined based on rankings for invasiveness, potential to spread, and impact on socio-economic and environmental assets. There are currently 32 WoNS with each having an endorsed strategic plan which outlines tactics and actions for control
- Declared Weeds - species which have been identified for control, eradication, or prevention of entry in all or part of the Northern Territory under the *Weeds Management Act 2001*. Declared weeds can be of the following classes:
 - Class A – to be eradicated
 - Class B – growth and spread to be controlled
 - Class C – not to be introduced into the Northern Territory
- Priority / alert weeds – species which have been identified as a priority or alert weed species within the Alice Springs Regional Weed Management Plan 2013-2018.

Based on a 50 km radius from the Mamlambo-1 well clearance area the weeds identified in Table 5-63 have been locally recorded.

Table 5-63 Weeds (Mamlambo-1 Well)

Scientific Name	Common Name	WONS	Declared	Priority / Alert
<i>Cenchrus echinatus</i>	Mossman river grass		✓	
<i>Tribulus cistoides</i>	Caltrop - cistoides		✓	
<i>Tribulus terrestris</i>	Caltrop - terrestris		✓	

A baseline weed assessment was undertaken of the Mamlambo-1 well clearance area by a suitably qualified person in February 2020 and no WONS or declared weeds were observed. Buffel Grass (*Cenchrus ciliaris*), a priority weed, was detected within the existing camp location.

5.5.2.8 Introduced Fauna (Pests)

An introduced fauna species is considered in this EMP to be of management concern if it is:

- Listed in the Northern Territory Fauna Atlas as “Introduced” and has been recorded within a 50 km buffer of the Mamlambo-1 well clearance area or has been recorded on ecological surveys of the area; or
- Identified as an invasive species by an EPBC PMST report within a 50 km buffer of the Mamlambo-1 well clearance area or has been recorded in ecological surveys of the area.

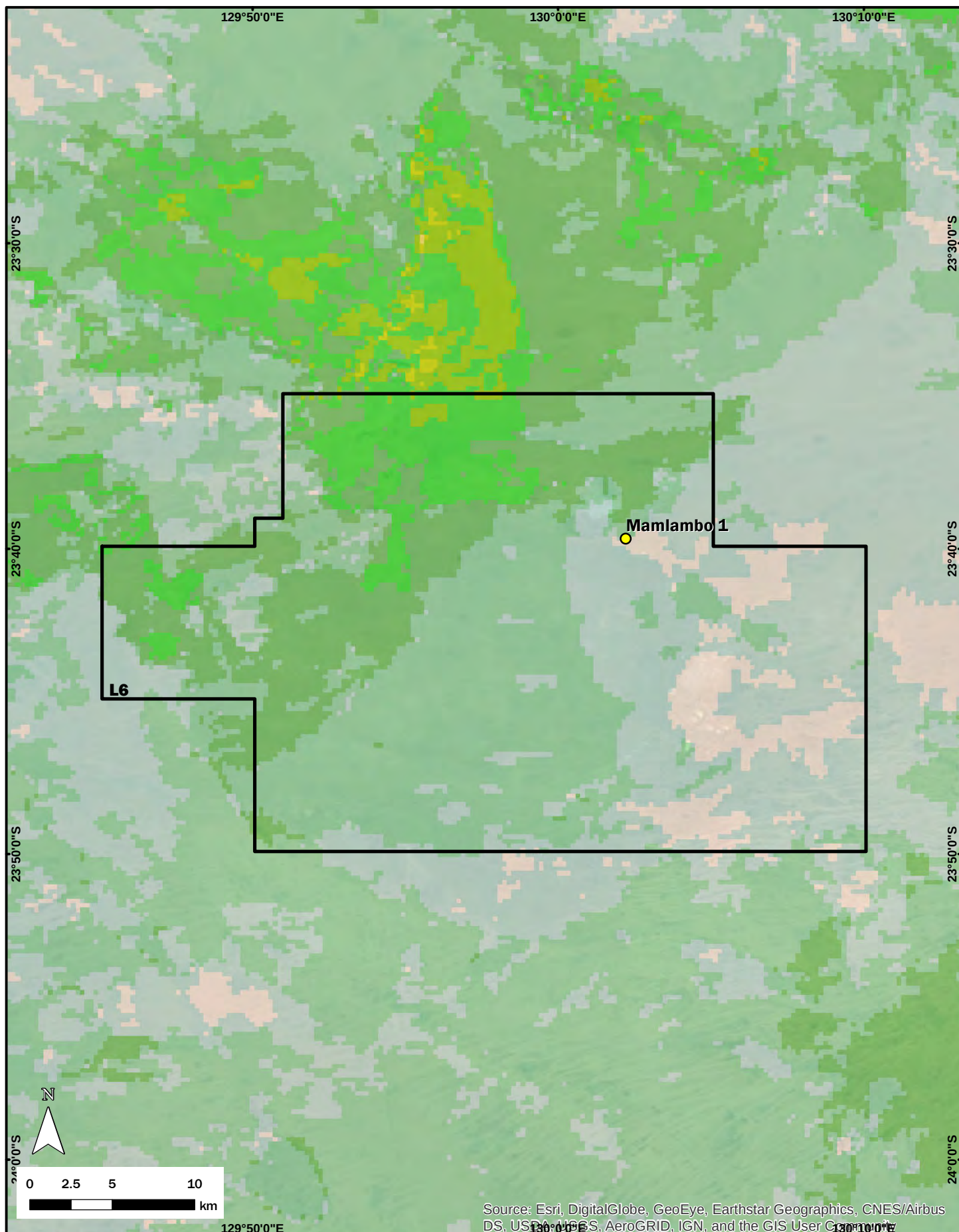
Table 5-64 provides an overview of the introduced fauna within 50 km of the Mamlambo-1 well clearance area.

Table 5-64 Introduced Fauna (Mamlambo-1 Well)

Class	Common name	Scientific name	NT Atlas	PMST Report	Ecological Survey
Mammal	Camel	<i>Camelus dromedarius</i>		✓	✓
Mammal	Cat	<i>Felis catus</i>		✓	
Mammal	Fox	<i>Vulpes</i>	✓	✓	
Mammal	Horse	<i>Equus caballus</i>	✓	✓	
Mammal	House Mouse	<i>Mus musculus</i>	✓		
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓	

5.5.2.9 Fire History

NAFI records show that fire frequency in the wider Surprise field is mixed with the north-west and western parts of the field experiencing up to 5 fire events since 2000. The Mamlambo-1 well is located in the eastern part of the field which has experienced up to 3 events since 2000. The Mamlambo-1 well clearance area was burnt in 2011 as part of wide-scale fires throughout the region (the clearance area has minor fire damage). The access track area was recently burnt in 2019 as part of wide-scale fires throughout the region.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

ID: 0523-11

Rev:

Date: 1/06/2020

Map Scale is 1:304,810 when printed at A4
Coordinate System: GCS GDA 1994

Fire frequency - Darwin Centre for Bushfire
Research 2020

Figure 5-54 Fire Scar Mapping (Mamlambo 1 Well)

- Indicative well location
- Permit
- Years burnt 2000 - 2019
- Unburnt
- 1
- 2
- 3
- 4
- 5
- 6
- 7



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5.5.3 Socio-economic Environment

An overview of the Mamlambo tenure and the locations of the Mamlambo-1 well in relation to populated places, roads, infrastructure and places of interests are provide in Figure 5-55.

5.5.3.1 Land Tenure

The proposed Mamlambo-1 well is located on Aboriginal land belonging to the Haasts Bluff Aboriginal Land Trust. CP has existing relationships with the Haasts Bluff Aboriginal Land Trust through other petroleum infrastructure located on their land.

The L6 tenure has no reserve blocks over the tenure. There is a small area on the northern area of L6 that has some proposed petroleum reserves. L6 is an operating and producing field and under the Petroleum Reserve Block Policy this tenure is exempt.

5.5.3.2 Surrounding Populated Places

Populated places close to the Mamlambo-1 well are:

- Kintore, approximately 100 km to the north-west
- Alice Springs, approximately 500 km to the east.

5.5.3.3 Traffic

Traffic is discussed in Section 4.8.6, which indicates that traffic volumes associated with the project will be minor.

In addition, further controls are and will be in place to reduce the impact and keep other road users safe. All access tracks associated with the Surprise Oil Field are clearly signed for authorised vehicles only. The turn in and turn offs of NT controlled roads are currently being used by CP operations and no further upgrades are required. Where vehicles associated with the Project are causing significant dust on NT controlled roads, vehicle speeds will be reduced. Oversized loads will be accompanied by an accredited Pilot.

CP will have a Traffic Management Plan in place which is approved by the DIPL to mitigate any potential traffic impacts to these areas associated with activities at the Mamlambo-1 well.

5.5.3.4 Workforce

Workforce numbers for each activity during the drilling campaign are discussed in Section 4.2.

- Due to the short nature of the activity, local resourcing strategy and utilisation of onsite drill rig operator camps the overall impact of the project should be positive to the local community. This assessment is based on the following:
- All contractors and employees will operate under a Pandemic (COVID-19) Management Plan which ensures here will be no direct interactions with vulnerable remote communities, pre-arrival assessment and daily monitoring of workers health, etc
- There will be no impacts on the demographics of the regional population from the drilling campaign
- CP will prioritise local resourcing, there will be contracts available and employment opportunities for a positive effect on the local business and services
- Housing and accommodation impacts will be minimised as the drill rig operator mobilises onsite camps for their own workforce. These are camps are located away from communities and there will be no resulting adverse impacts.
- there will be a positive impact to lodging and services businesses in Alice Springs on crew change over days (expected 1 overnight in Alice Springs). Crew rotations will be managed to ensure that the services in Alice Springs are not overwhelmed and can continue to accommodate for tourists.

- Crews flying / driving in and out of Alice Springs will be bussed to the camp to reduce light vehicle traffic on regional roads
- CP will also explore opportunities to provide education and training opportunities to promote the gas industry, integrate the NT gas story into the tourism experience and include STEM (science, technology, engineering and mathematics) learning into local schools with technical experts and guided field trips to CP operations.

5.5.3.5 Cultural Heritage

5.5.3.5.1 Historic and Natural Heritage

The Mamlambo-1 well is located within the MacDonnell Shire. An online search of the NT heritage register showed 18 publicly listed heritage sites in the MacDonnell Shire, none of which are located in the within the Dingo wells clearance area. No non-public sites were found by the online search.

The EPBC PMST report for the Mamlambo-1 well did not identify any World Heritage Properties, National Heritage Places, Commonwealth Heritage Places or Places on the Register of National Estate within or within a 50km buffer of the Mamlambo-1 well clearance area (refer Appendix 2).

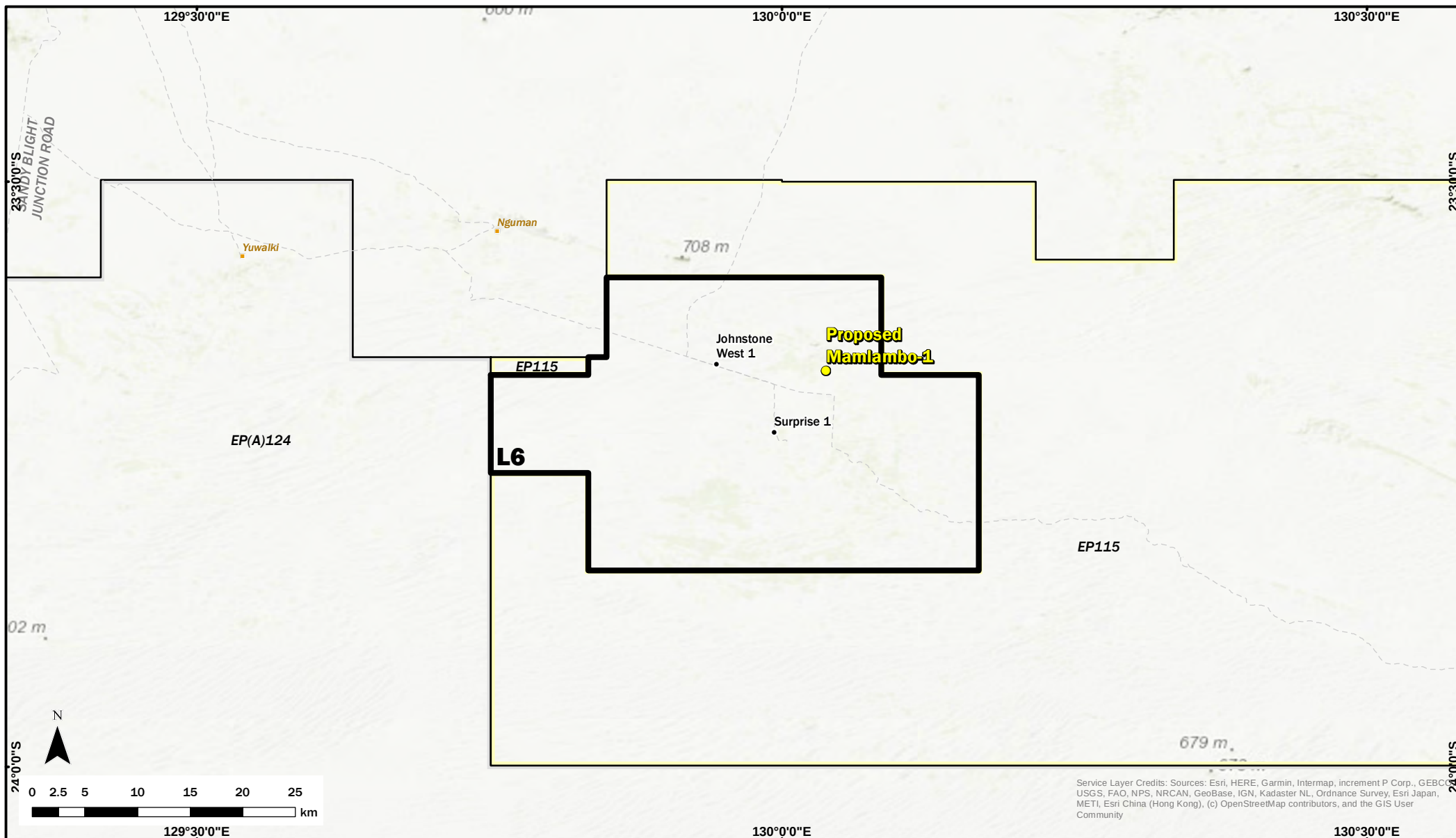
5.5.3.5.2 Aboriginal Archaeological Assessment

An Aboriginal archaeological assessment of the Mamlambo-1 well clearance area was undertaken by Everick Heritage in February 2020 to assess the potential impact of the drilling program on declared heritage places (i.e. all Aboriginal archaeological places) protected under the *Heritage Act 2011* (refer Appendix 3). During the assessment, one find was made along the proposed access track which requires amongst other things an exclusion area within the clearance area and further 10 m buffer from the exclusion area for any ground disturbance. CP is implementing the recommendations made in the assessment report to avoid any impacts on this find. As no impacts are anticipated, a works approval is not required.

The Everick Heritage report includes an Aboriginal Objects Find / Stop Work Procedure which CP will implement at the Mamlambo-1 well.

5.5.3.5.3 Aboriginal Sacred Sites

In accordance with the *Aboriginal Sacred Sites Act 1989*, CP has obtained an Authority Certificate from the AAPA for the Mamlambo-1 well (Certificate # C2020/058). CP commits to complying with the requirements of the granted Authority Certificate. Additionally, CP will also obtain a Sacred Site Clearance Certificate from the Central Land Council for the Mamlambo-1 well



ID: 0513-012-MAP
 Rev: B
 Date: 18/08/2020
 Map Scale is 1:500,000 when printed at A4
 Coordinate System: GCS GDA 1994
 Source:
 Aboriginal Communities - Department of
 Infrastructure, Planning and Logistics 2020

Figure 5-55 Mamlambo locality map

- Proposed Mamlambo 1
- Petroleum Wells
- Aboriginal Communities
- Track
- ▭ CTP Permit Application
- ▭ CTP Granted Permit
- ▭ L6

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6.0 Environmental Risk Assessment

CP acknowledges that environmental risks are inherent in some onshore oil and gas activities, and without control, environmental impacts may arise. As such, the Regulations require detailed assessment, reduction and control of these environmental risks and impacts through the development and implementation of the EMP for the project. This section provides an overview of the environmental risk assessment process.

6.1 Risk Management Approach

CP ensures that risks associated with this planned activity are systematically identified, assessed and managed to mitigate any potential impact to the environment. CP's risk management approach is aligned with all material aspects of ISO 31000 and all environmental risks associated with the project have been:

- Identified to determine the environmental values and / or sensitivities with the potential to occur as a result of the project
- Analysed and evaluated including the assessment of control effectiveness (refer Table 6-1)
- Recorded in a risk register
- Treated in a manner commensurate with the level of risk (formal risk management plans, detailed risk treatments, routine management)
- Communicated to key stakeholders (note: due to COVID restrictions and other unforeseen impacts this has been limited)
- Monitored and reviewed in a manner commensurate with the level of risk, and the retained consequences.

Assessment of risk is completed using CP's Risk Matrix (Section 6.6) to assess and rate risks by assessing the combination of likelihood of occurrence and the severity of the impact / outcome of an event. This allows quantification of the risk and determination can then be made about whether the risk is ALARP and acceptable (Section 6.4), or whether further mitigation is required.

CP's risk management evaluates and reviews the inherent risk from an activity, the residual risk once controls are applied and the likelihood and consequence of a risk event. A key factor in determining the residual risk rating is the effectiveness of controls / mitigation measures. The review includes the effectiveness of the risk controls / mitigation measures to meet CP's objective of ALARP and acceptability.

The results of CP's risk management approach for activities under this EMP are contained in Table 6-5. The CP Drilling and Completions Manager is the owner of the risks associated with activities under this EMP.

Table 6-1 Control Effectiveness

Assessment	Description
Effective	Controls are well designed and are operating effectively, and management monitoring and review of controls are established.
Satisfactory	Controls are reasonably well designed, and most aspects are operating effectively with some minor areas for improvement.
Needs Attention	Certain control/s are not well designed and/or are systematically not operating effectively.
Ineffective	Significant gaps in the design and operation of controls. No confidence that any degree of control is being achieved.

6.2 Hierarchy of Controls

To mitigate a risk to ALARP, CP is required to demonstrate that all reasonably practicable control measures have been identified and implemented to reduce the risk of identified hazards. CP uses the hierarchy of controls listed in Table 6-2 to determine whether a risk has been mitigated to ALARP. In determining whether a risk is at ALARP, CP considers whether the introduction of additional controls to reduce the risk are possible and if they are, would they be considered reasonable or practicable (for example if a residual risk is already at low, then it is not possible reduce the risk any further and therefore the adoption of any additional control measures would not be reasonable or practicable).

Table 6-2 Hierarchy of Controls

Hierarchy	Description	Effectiveness of Control
Eliminate	Hazard is physically removed	Highest  Lowest
Substitute	Hazard is replaced	
Engineering	The hazard remains but is isolated	
Administrative	People are required to change the way they work	
Personal Protective Equipment	Hazard remains but people are protected using equipment	

6.3 ALARP

As part of CP's risk assessment process, each risk is mitigated to ALARP. A risk can be considered to have been reduced to ALARP when all reasonably practicable control measures have been identified and implemented to reduce the risk of identified hazards. ALARP essentially involves making a judgement about whether all reasonably practicable measures are in place to control a potential risk or impact considering the level of consequence and cost, time and resources involved to mitigate it. CP considers where the residual risk is low it cannot be reduced further, therefore it is ALARP.

It is important to note when discussing ALARP and risk acceptance that practicability and the reasonability of control measures can change over time due to changes in technology, industry standards and community acceptance.

6.4 Determination of Impact and Risk Acceptability

To determine whether potential environmental risks and inputs are 'acceptable' is a matter of judgement that depends on issues such as the nature and scale of impacts and the social or economic benefits. In determining acceptability, the Regulations require consideration of the principles of ESD. With this in mind, CP's risk tolerance / acceptance process is utilised to determine whether to accept the assessed residual risk rating. In summary:

- 'Very High' residual risks are not tolerable / acceptable long term and must be supported by a comprehensive assessment and improvement plan to reach an acceptable level. 'Very high' residual risks must be approved by CP's Chief Executive Officer
- 'High' and 'Medium' residual risks are acceptable provided that ALARP has been achieved and demonstrated
- 'Low' residual risks are acceptable, and it is assumed that ALARP has been achieved.

In addition to the requirements detailed above, for the purposes of petroleum activities, impacts and risk to the environment are considered broadly acceptable if:

- The residual risk is determined to be 'Low', the controls are determined to be effective and the scientific uncertainty score is A (low) or

- The residual risk is determined to be either 'High' or 'Medium', the controls are determined to be effective and the scientific uncertainty score is A (low) as well as ALARP being demonstrated through:
 - Alignment with legislative requirements, regulator guidance, stakeholder expectations
 - Consistent with regional strategies and plans
 - Not compromising ESD Principles
 - Limiting the nature and scale of the effect on the environment.

6.5 Assessment of Uncertainty

To enable an accurate assessment of the potential impact and risk of the activities, the risk assessment process must include consideration of scientific uncertainty regarding the information available to assess the risk. Uncertainty is high where confidence in the available information is low in identifying risk or the effectiveness of a management control. Additional baseline studies or other safeguards may be required to increase the accuracy of an assessment to determine the acceptability of a risk.

Scientific uncertainty is qualitatively assessed using a generic means of ranking the data available. CP uses the system described in Table 6-3 to assess the uncertainty in its risk assessment. Considerations of scientific uncertainty have been included in the risk assessment.

Table 6-3 Scientific Uncertainty Scoring System

Category	Description	Decision Making Tools
A (low)	Control / mitigation measures are well understood and established within the industry to ensure the risk is effectively controlled Information available to assess the risk is current	Legislation, codes and standards exist to regulate the activity Good industry practice includes additional controls beyond legislation, codes and standards
B (moderate)	Control / mitigation measures exist and have been demonstrated as effective in other industries Information used to assess the risk is still valid but is either starting to date or there are information gaps	Risk based assessment tools are available for use (e.g. modelling, quantitative risk assessment, cost benefit analysis etc)
C (high)	Scarce or no data available to support the assessment of the risk	Generally, no guidance material available. The precautionary approach to management of the risk is required.

6.6 Central Petroleum Risk Matrix

Table 6-4 Central Petroleum Risk Management Approach

Risk Matrix							Remote	Unlikely	Possible	Likely	Frequent	
							Conceivable, but only in extreme circumstances	Event is unlikely to occur during the life-span of a project	Event may occur during the life-span of a project	Event likely to occur during the life-span of a project	Recurring event during the life-span of a project	
Impact Level	Impact Type						<1% chance of occurring within the next year.	>1% chance of occurring within the next year	>10% chance of occurring within the next year	>30% chance of occurring within the next year	>60% chance of occurring within the next year	
	Health and Safety	Environment	Community	Legal	Reputation	Financial AUD\$						
	Extreme	5 or more fatalities or life-threatening injury / illness or total permanent disability.	Extensive permanent impact on / off site or damage to critically endangered species, habitats, ecosystems.	Extensive irreversible impacts to the community or social wellbeing. Long term social unrest. Permanent damage to area/s of cultural significance.	Charges against any director or senior executive involving jail, substantial fine or loss of right to manage the company. Public inquiry – requiring considerable resources and senior executive time. Loss of an asset or loss of licence to operate an asset. Permanent non-voluntary suspension of trading CTP securities on the ASX.	Multiple stakeholder groups confirming coordinated action, as reflected in media channels with significant reach and influence. Negative international or prolonged national media (e.g. 2 weeks).	Loss of value in excess of \$20m Cashflow impact in excess of \$5m	High	Very High	Very High	Very High	Very High
		Critical	1-4 fatalities or life-threatening injury / illness or total permanent or partial disability.	Extensive long term partially reversible impact on / off site or damage to endangered species, habitats, ecosystems.	Extensive reversible impacts to the community or social wellbeing. Prolonged community outrage. Extensive long term partially reversible damage to area/s of cultural significance.	Charges against any director, senior executive or senior manager involving fines, jail or the loss of right to manage the company. Prolonged major litigation – exposure to significant damages, fines or costs. Suspension or restrictions to the benefit of an asset or operate an asset. Prolonged non-voluntary suspension of trading CTP securities on the ASX.	Multiple stakeholder groups mobilising and encouraging other to act, as reflected in media channels with significant reach and influence. Negative media national for 2 days or more.	Loss of value >\$10m to \$20m Cashflow impact >\$1m to \$5m	High	High	High	Very High
	Serious	Injury or illness resulting in partial disability, lost time or alternative / restricted duties.	Long term reversible impacts on / off site or to vulnerable or near threatened species, habitats, ecosystems.	Impacts to the community or social wellbeing. High levels of community tension. Long / medium term partially reversible damage to area/s of cultural significance.	Charges against any employee (not described above). Non-compliance with conditions of licence to own or operate an asset or to conduct an activity. Litigation - exposure to damages, fines or costs. Short-term non-voluntary suspension of trading CTP securities on the ASX.	More than one stakeholder group’s opinion or view influencing other stakeholders, reported through media channels with some reach and influence. Negative national / state media for 1 day.	Loss of value >\$2.5m to \$10m Cashflow impact >\$500k to \$1m	Medium	Medium	High	High	High
		Moderate	Injury or illness to 1 or more people resulting in medical treatment.	Medium / short-term impact on / off site or to low risk / least concern / common regional species, habitats, ecosystems.	Small scale impacts to the community or social wellbeing. Isolated examples of community tension. Moderate short-term impact to areas of cultural significance.	Moderate non-compliance with external mandatory obligations or breach of contractual or other legal obligations (not described above). Litigation possible. Non-compliance with internal controls with a moderate impact	A single stakeholder group drawing attention to an incident, issue, or approach conveyed through local media channels.	Loss of value >\$500k to \$2.5m Cashflow impact >\$250k to \$500k	Low	Medium	Medium	Medium
	Minor		Injury or illness requiring first aid to 1 or more people, or no treatment recorded.	Minor near source impact on / off site – readily dealt with.	Minor community impact / short-term impact to areas of cultural significance – readily dealt with.	Minor non-compliance with external mandatory obligations or breach of contractual or other legal obligations. Non-compliance with internal controls with a minor impact.	A person or organisation within a stakeholder group signalling an interest in an incident, event or approach, using channels with limited reach or influence. Public concern restricted to local complaints.	Loss of value >\$250 to \$500K Cashflow impact >\$50 to \$250k	Low	Low	Low	Medium

6.7 Risk Assessment

Table 6-5 Detailed Risk Assessment

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
Groundwater	Decline in water levels due to cross-flow of groundwater to another formation	Wellbore failure due to incomplete cement placement or casing failure during construction to post abandonment.	- Surrounding production bores suffer impaired capacity - Reduced environmental flows in connected springs/rivers	Serious	Possible	High	Dingo-1 ST1 well - Conductor, surface casing and intermediate casing strings have already been cemented from shoe to surface (engineering). - Newly run production casing to be planned to be cemented from base of the Chandler formation to surface (engineering) - There will be three strings of casing and cement across known drinking water aquifers (engineering) Dingo-5 well - Deep set 20" and 13 3/8" conductors and 10 3/4" intermediate casing will be cemented from shoe to surface (engineering) - Production casing will also be cemented from base of the Chandler formation to surface (engineering) - There will be two strings of casing and cement across known deep water aquifers (engineering) - There will be three strings of casing and cement across known shallow drinking water aquifers (engineering) Mamlambo-1 well - A deep set conductor will be set at ~ 25m below ground level and cemented back to surface to isolate potential water sources at ~ 18m (engineering) - intermediate casing will be set at ~ 280m below surface and cemented to surface (engineering) - The final casing string will be cemented from surface to 1,050m and cemented back to surface isolating the potential deep aquifer at ~ 767m (engineering) - There will therefore be two strings casing and cement across known shallow water aquifers and one at the deeper potential aquifer (engineering)	Effective	Serious	Remote	Medium	A (Low)	Clause B.4.1 Clause B.4.2 Clause B.4.3 Clause B.4.6 Clause B.4.7 Clause B.4.11	Construction of each of the wells is undertaken in accordance with the Code of Practice which is the industry requirement in the NT. Multiple barriers will be installed across aquifers to ensure isolation. Cement bond logs and pressure testing of each of the strings will occur to confirm that control measures have met design requirements. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
	Local contamination of utilised aquifer leading to impaired capacity of water bores	Cross flow of water and/or gas from deeper formations into a utilised aquifer	Groundwater quality unsuitable for current or future users	Serious	Possible	High	Palm Valley-12 well - Two conductors will be run. A shallow 20" conductor will be set and cemented to surface at 25m. A deep 2nd API 5CT compliant conductor casing will be run to 400m and cemented to surface (engineering) - An intermediate casing string will be run and cemented to surface from 1100m (engineering) - The production casing will not be run to surface. It will be hung from a liner hanger that sits in the intermediate casing string. The liner will be cemented from bottom to the liner hanger (engineering) - There will be a minimum of two casing strings across all known aquifers (engineering) All Wells - Well to be constructed and operated in accordance with an approved WOMP (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause B.4.1 Clause B.4.2 Clause B.4.3 Clause B.4.6 Clause B.4.7 Clause B.4.11	Construction of each of the wells is undertaken in accordance with the Code of Practice which is the industry requirement in the NT. Multiple barriers will be installed across aquifers to ensure isolation. Cement bond logs and pressure testing of each of the strings will occur to confirm that control measures have met design requirements. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.
	Contamination of aquifers impacts existing groundwater users and environmental dependencies	Uncontrolled discharge of formation water / hydrocarbon to groundwater due to well integrity failure	Groundwater quality unsuitable for current or future use by users or the environment	Serious	Possible	High	- All casing and cement designs are submitted in a WOMP and approved by the NT DITT as per clause 301 of the Onshore Schedule (administrative) - Verified integrity of the casing strings and cement - All casing strings run in the hole comply to API 5CT and are pressure tested once run (except conductor that cannot be tested) (engineering) - Cement designs are verified by a 3rd party and submitted in the WOMP for NT DITT review and approval (engineering) - The cement is pumped by a professional 3rd party contractor and verified through cement reports that are also submitted to the DITT (administrative) - Quality and placement of casing cement is also verified through an independent 3rd party cement bond log post pumping. (except conductor that cannot be logged) (administrative) - Well barrier integrity report is required to be verified and then submitted to the DITT (administrative).	Effective	Serious	Remote	Medium	A (Low)	Clause B.4.1 Clause B.4.2 Clause B.4.3 Clause B.4.6 Clause B.4.7 Clause B.4.11	Construction of each of the wells is undertaken in accordance with the Code of Practice which is the industry requirement in the NT. Multiple barriers will be installed across aquifers to ensure isolation. Cement bond logs and pressure testing of each of the strings will occur to confirm that control measures have met design requirements. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
	Groundwater extraction for project purposes impacts on existing users and environmental dependencies	Groundwater extraction for project activities causes the decline in groundwater levels in source aquifers	- Surrounding bores suffer impaired capacity - Reduced environmental flows in connected springs/ivers	Serious	Possible	High	- Locally sourced groundwater will not be utilised for Dingo wells, Palm Valley-12 well and Orange-3 wells (elimination) - Existing CP bores will be utilised for Mamlambo-1 and West Mereenie wells (engineering) - Estimated groundwater requirement from CP bores is approximately 3.6ML. No other surrounding users at Mamlambo-1. Only intermittent use for road construction within 10km at Mereenie. - Water extraction licence to be obtained prior to use	Effective	Minor	Remote	Low	A (Low)	NA	No new groundwater bores are proposed as part of the drilling program. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Groundwater extraction from project activities	Groundwater inflow during air drilling causes the decline in groundwater levels in source aquifers	- Surrounding bores suffer impaired capacity - Reduced environmental flows in connected springs/ivers	Moderate	Unlikely	Medium	- Realtime monitoring of downhole conditions. In the event of significant groundwater influx while drilling with air, drilling fluid will be converted to a mud-based fluid system (substitution) - Sufficient mud-based fluids are available at the well lease to convert to a mud-based fluid system (administrative)	Effective	Moderate	Remote	Low	A (Low)	Clause B.4.1 Clause B.4.10	The mud-based system will contain loss circulation materials which are designed to 'plug' any holes in the well that may be allowing groundwater inflow. The use of loss circulation materials in drilling muds is the standard industry practice across the world for drilling petroleum wells. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Contamination of aquifers impacts existing groundwater users and environmental dependencies	- Leakage due to tank/storage integrity breach - Loss of containment during onsite transfer of fluids - Storage and transport of chemicals during the wet season	Groundwater quality unsuitable for current or future use by users or the environment	Moderate	Possible	Medium	- All chemicals, hazardous substances and dangerous goods stored in bunded areas (engineering) - Drill sump to be lined (engineering) - Chemical mixing area and drilling fluid tanks will be surrounded by a drain that terminates in the lined drill sump (engineering) - Implement Spill Management Plan (administrative) - Implement Wastewater Management Plan (administrative) - Implement Emergency Response Plan for incidents beyond the scope of the Spill Management and Wastewater Management Plan (administrative) - Spill kits are available where hazardous materials are used and personnel trained in their correct use (administrative)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.8 Clause B.4.10 Clause B.4.16 Clause C.7.1 Clause C.7.2	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Inadequate storage capacity in drill sump		Moderate	Possible	Medium	- Sumps to maintain a 0.1% AEP event freeboard (engineering) - Flood controls for the wells prevent up to a 1% AEP event from reaching the sump (engineering) - Implement Wet Season Operations Management Plan (administrative) - Utilise a licenced waste transporter for the transfer of wastewater for re-use, recycling, treatment and/or disposal	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.1 Clause A.3.8	The Code of Practice requires storages of waste water to meet the 0.1% AEP freeboard requirement. CP has committed to this freeboard. Flood controls will prevent a 1% AEP event from reaching the sump. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Local contamination of utilised aquifer leading to impaired capacity of water bores	Significant loss of drilling fluids into a utilised aquifer	Groundwater quality unsuitable for current or future use by users	Moderate	Unlikely	Medium	- Realtime monitoring of downhole conditions so loss circulation materials can be added to the mud system when losses are detected. - Production zone of well to be drilled with air or mist, therefore low potential for drilling fluid loss. - Loss circulation material available on site (as per the approved drilling program)	Effective	Moderate	Remote	Low	A (Low)	Clause B.4.1 Clause B.4.2 Clause B.4.9 Clause B.4.11	The drilling program preferentially uses air/mist drilling which reduces the need for mud-based drilling fluids to be used. Where mud-based drilling is undertaken, loss circulation materials are added when losses are detected to 'plug' any holes. Detection of loss of drilling fluid is performed in real-time so changes to the system can be made quickly to avoid significant losses. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
Surface Water	Contamination of surface waters	Failure of storage / mixing tanks	- Aquatic fauna / flora death - Surface water unsuitable for primary / secondary contact	Moderate	Possible	Medium	- Implement Wastewater Management Plan (administrative) - Diesel tanks to have secondary containment (engineering) - Daily monitoring of tank levels whilst drilling and production testing (administrative) - Mixing tanks will be surrounded by a drain that directs fluids to the sump	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.8 Clause C.7.1 Clause C.7.2	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Overtopping of sumps and storage/ mixing tanks		Moderate	Possible	Medium	- Sumps to maintain a 0.1% AEP freeboard (engineering) - Mixing tanks will be surrounded by a drain that directs fluids to the sump (engineering) - Daily monitoring of sump levels whilst drilling and testing (administrative) - Implement Wet Season Operations Management Plan (administrative)	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.8 Clause C.7.1 Clause C.7.2	The Code of Practice requires storages of wastewater to meet the 0.1% AEP freeboard requirement. CP has committed to this freeboard requirement. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Spills / leaks from: - Onsite storage, handling use and transfer of chemicals, dangerous goods and hazardous substances - Storage and transportation of wastes and wastewaters - Storage and transport of chemicals during the wet season - Contaminated hydrotest water used for irrigation		Moderate	Possible	Medium	- Undertake inspection of locations for leaks/spills and rectify where detected (administrative, engineering) - Ensure all fittings and equipment are checked and maintained (administrative, engineering) - Ensure that any spills, leaks or points of excessive wear are appropriately reported, and the necessary maintenance work and control measures undertaken (administrative, engineering) - Provide portable spill containment equipment (e.g. spill trays) at each of the facilities (engineering) - Provide spill response kits appropriate for the types of spills possible at each location (engineering) - Store wastes in secured containers (engineering) - Store liquid wastes in a bunded and impervious area (engineering) - Implement Spill Management Plan (administrative) - Implement West Season Operations Management Plan (administrative) - Utilise a licenced waste transporter for the transfer of wastewater for re-use, recycling, treatment and/or disposal - Test hydrotest water prior to irrigation	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.1 Clause A.3.8 Clause C.7.1 Clause C.7.2	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Release of captured dirty stormwater		Moderate	Possible	Medium	Implement Erosion and Sediment Control Plan (engineering, administrative)	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.1 Clause A.3.4 Clause A.3.8	Erosion and Sediment Control plan has identified measures to be undertaken in regard to devices to treat dirty stormwater before its release. The Plan has been prepared by a suitably qualified person. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Erosion and sediment releases	- Aquatic fauna / flora death - Siltation of surface waters	Moderate	Possible	Medium	- Implement Erosion and Sediment Control Plan (engineering, administrative) - Utilise existing tracks as much as possible to minimise additional disturbance (engineering, administrative) - Waterways will be avoided where possible and the ESCP will define the set-backs to be maintained (engineering, administrative) - Inspect locations following significant rainfall events (>15 mm in 24 hours) to determine extent of erosion and remedial actions to be taken	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.1 Clause A.3.4 Clause A.3.8	Erosion and Sediment Control plan has identified measures to be undertaken in regard to devices to minimise erosion and sediment releases. The Plan has been prepared by a suitably qualified person. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Run off from sewage irrigation areas	- Aquatic fauna / flora death - Surface water unsuitable for primary / secondary contact	Moderate	Possible	Medium	- Effluent irrigation area designed in accordance with Department of Health, Code of Practice for Onsite Wastewater Management (2014) (engineering) - Irrigation areas located greater than 200 m from nearest watercourse (engineering) - Irrigation ceases during significant rainfall events (>15 mm in 24 hours) (administrative)	Effective	Moderate	Unlikely	Low	A (Low)	Clause A.3.1 Clause A.3.4 Clause A.3.8	Irrigation area will be designed in accordance with NT government requirements. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Flood event (1% AEP)	- Aquatic fauna / flora death - Surface water unsuitable for primary / secondary contact	Moderate	Possible	Medium	Diversion structures as outlined in the Flood Study (refer Appendix 1) to be implemented	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.1	Diversion structures (where required) are designed to withhold a 1% AEP rainfall event at each of the wells Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
Land	Loss in long term soil productivity and viability	Soil compaction during vehicle movements and civil works (e.g. access tracks, well leases, camp areas)	- Failed rehabilitation - Landowner complaints - Additional costs to remediate	Serious	Possible	High	- Compacted areas to be deep ripped to encourage infiltration and water retention (engineering) - Implement Rehabilitation Management Plan (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.9	The Rehabilitation Management Plan has been developed by a suitably qualified person and is designed to ensure that at the completion of activities the land is returned to its pre disturbance land use capability The plan contains what would be considered standard practices in the NT for rehabilitation. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Topsoil not preserved (including separation from subsoils)		Moderate	Possible	Medium	- Topsoil to be stripped and stockpiled (engineering) - Topsoil stockpiles not to be in overland flow paths / drainage lines (engineering) - Topsoil stockpiles will have erosion and sediment control measures installed (as per the Erosion and Sediment Control Plan) (engineering)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.1 Clause A.3.4	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Soil erosion from cleared areas	- Loss of soil productivity - Increased watercourse sedimentation loads - Topography changes	Moderate	Possible	Medium	Implement Erosion and Sediment Control Plan (engineering, administrative)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.4	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
	Soil contamination	- Spills / leaks from onsite storage, handling use and transfer of chemicals - Storage and transportation of wastes and wastewaters - Failure of sumps - Failure of aboveground flowlines - Storage and transport of chemicals during the wet season - Contaminated hydrotest water used for irrigation	- Failed rehabilitation - Groundwater / surface water contamination - Additional costs to remediate	Moderate	Possible	Medium	- Implement Wastewater Management Plan (administrative) - Tanks and chemical storage areas to have secondary containment (engineering) - Chemical mixing area and drilling fluid mud tanks will be surrounded by a drain that terminates in the lined, mud sumps (engineering) - Provide portable spill containment equipment (e.g. spill trays) at each of the facilities (engineering) - Sumps are lined (engineering) - Material in sump to be tested if suitable for burial onsite or if offsite disposal is required - Provide spill response kits appropriate for the types of spills possible at each location (engineering) - Wastes stored in secured containers (engineering) - Liquid wastes to be stored in a bunded and impervious area (engineering) - Undertake inspection of locations for leaks/spills and rectify where detected (administrative, engineering) - Ensure all fittings and equipment are checked and maintained (administrative, engineering) - Ensure that any spills, leaks or points of excessive wear are appropriately reported, and the necessary maintenance work and control measures undertaken (administrative, engineering) - Implement Spill Management Plan (administrative) - Implement Wet Season Operations Management Plan (administrative) - Test hydrotest water prior to irrigation - Utilise a licenced waste transporter for the transfer of wastewater for re-use, recycling, treatment and/or disposal	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.8 Clause C.7.1 Clause C.7.2	The Wastewater Management Plan, Spill Management Plan and Wet Season Operations Management Plan address the requirements of the Code of Practice and have been developed by a suitably qualified person. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Failure of flowlines	- Failed rehabilitation - Groundwater contamination	Moderate	Possible	Medium	Aboveground Flowlines - West Mereenie wells - the flowlines are not co-located with the access track to decrease likelihood of accidental vehicle damage (engineering) - Palm Valley-12 well – adjacent to the existing access track the flowline is to be co-located with an existing aboveground flowline. - Both flowlines to have asset protection along the route (fencing, bollards and traffic controls) (engineering) - Site inductions includes information on the location of aboveground flowlines and safe driving conditions to be applied (administrative) All Flowlines - Flowline to be constructed in accordance with Australian Standard 2885 (engineering) - Flowline to be pressure tested prior to becoming operational (engineering) - Flowline pressure monitored continuously to detect any failures as they occur (administrative) - Flowline integrity inspections to be undertaken in accordance with the existing approved Field EMPs (administrative) - The flowline route represents the most direct route (taking into account other constraints) to connect with the existing network (engineering)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.1	Aboveground Flowlines Palm Valley-12 well is located in the undulating rocky plateau land type. CP's experience in these land types is that below ground installation of flowlines is difficult given the high quantity of rock present. The West Mereenie wells are part of an existing field development for which their flowlines are to connect with existing above ground infrastructure. In 5 years of CP operating the field, there have been no instances of aboveground flowline failures due to damage from vehicles / equipment Flowlines contain gas, so failure would result in primarily escape of emissions to air. Typically, less than 1% of volume is solid / liquid that could escape to land All Flowlines Flowlines are monitored in real time to detect any failures (via pressure changes) and will become part of the respective Field EMP's integrity inspection regime to detect potential failures. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
Air	Increase in air pollutants in areas surrounding activities	Emissions from combustion of diesel associated with civil works, drilling and well testing	Human and fauna respiratory ailments	Moderate	Possible	Medium	- All diesel used onsite is to be compliant with the Federal Government's <i>Fuel Quality Standards (Automotive Diesel) Determination 2019 (administrative)</i> - Vehicles and equipment will be switched off when not in use (administrative) - Onsite personnel to wear appropriate PPE (PPE) - No homesteads or communities located with 15 Km of any well leases (engineering)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.1	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Emissions from release of chemicals, hazardous substances and dangerous goods to atmosphere during onsite storage, mixing and use during drilling and well testing (particularly volatile organic compounds)	Human and fauna respiratory ailments	Minor	Possible	Low	- Chemicals, hazardous substances and dangerous goods stored in sealed containers (engineering) - Onsite personnel to wear appropriate PPE whilst mixing and use (PPE)	Effective	Minor	Remote	Low	A (Low)	Clause A.3.8	Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Emissions from gas releases / diesel combustion	- Contribution to greenhouse gas emissions - Human and fauna respiratory ailments	Minor	Frequent	Medium	- No planned venting of hydrocarbons to occur (administrative) - No venting of gas a flare will be used during drilling and well testing (engineering)All diesel used onsite is to be compliant with the Federal Government's <i>Fuel Quality Standards (Automotive Diesel) Determination 2019 (administrative)</i> - Flowlines to be pressure tested prior to becoming operational (administrative) - Flowline pressure monitored continuously to detect any failures as they occur (administrative) - Flowline integrity inspections to be undertaken in accordance with the existing approved Field EMPs (administrative) - Implement Methane Emissions Management Plan (administrative) - All pollutant emissions, including unplanned events and emissions from wastewater storage tanks will be reported via the National Pollutant Inventory (NPI) <i>Emission Estimation Technique Manual for Oil and Gas Extraction and Production Version 2.0</i> - All Greenhouse gas emissions shall be measured and reported in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS) <i>National Greenhouse and Energy Reporting (Measurement) Determination 2008</i>	Effective	Minor	Possible	Low	A (Low)	Clause D.5.1 Clause D.5.2 Clause D.5.4 Clause D.5.5 Clause D.5.6 Clause D.5.9	Greenhouse gas emission will be released as the drilling program relies upon fossil fuels for combustion. Diesel fuel which has a lower greenhouse gas contribution than petrol is used in all vehicles and the drill rig which account for the majority of fuel usage. Small equipment may still use petrol engines. Flaring will be undertaken rather than venting. Capture of any gas during the well testing phase is not practical given the relatively short period of testing and commercial viability of the captured gas. Once sufficient information has been obtained during testing the well will either be completed, cased and suspended or decommissioned. Monitoring of flowlines post initial pressure testing will be undertaken in accordance with the respective Field EMP for the well. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Bushfire as a result of accidental ignition at site	- Human and fauna respiratory ailments - Loss of flora / fauna habitat - Loss of fauna	Moderate	Possible	Medium	- Vegetation cleared from well leases and camps and stockpiled (engineering) - Vegetation stockpiles (and other infrastructure) to have a 4 m fire break (engineering) - Horizontal, inground flare system to be used (engineering) - Flare pit design (20 x 12 x 2.5m) (engineering) - Implement Bushfire Management Plan (administrative) - Designated smoking areas at each site (administrative) - Fire-fighting equipment available at each site (PPE) - Onsite personnel to be trained in use of fire-fighting equipment (administrative) - Ignition sources to be kept outside designated hazardous area (administrative) - Hazard areas to be included in onsite induction (administrative) - Implement Emergency Response Plan (administrative)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.7	Fire-fighting controls are designed to deal with small scale fires before they escalate to a larger bushfire. Flare pit design will be undertaken by a competent person to ensure flaring stays within the pit Firebreaks are as per the minimum requirements under the <i>Bushfires Management Act 2016</i>. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Nuisance from dust emissions associated with drilling activities	Dust generation as a result of vehicle movements associated with travel to site, civil works, drilling and well testing	- Human and fauna respiratory problems - Flora stress and/or dieback	Minor	Likely	Medium	- Water to be used for dust suppression (engineering) - Vehicle speeds limited to 60km/hr on unsealed tracks (administrative) - Onsite personnel to wear appropriate PPE (PPE) - No homesteads or communities located with 15 Km of any well leases (administrative)	Effective	Minor	Unlikely	Low	A (Low)	Clause A.3.1	Sensitive receptors are located considerable distances from the well locations. Risk mitigation measures are standard measures to manage dust generation. The measures do not eliminate the risk but seek to reduce the likelihood. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
Terrestrial flora / fauna	Significant decrease in population of conservation significant flora / fauna habitat	Clearing of vegetation for drilling program	▪ Injury or death of native fauna ▪ Loss of vegetation and fauna habitat ▪ Habitat fragmentation ▪ Increased GHG from loss of vegetation	Serious	Possible	High	▪ Baseline ecology assessments confirm locations of conservation significant flora and fauna habitat (administrative) ▪ Land disturbance locations are designed to avoid conservation significant flora and fauna habitat (engineering) ▪ This is not possible at PV12 due to other constraints. The removal of one individual will not significantly impact the overall population of the species. ▪ Land disturbance locations are designed to avoid land types that support conservation significant flora and fauna habitat (i.e. clay pans and dunes) (eliminate) ▪ This is not possible at MW27 and MW28 due to competing constraints The likelihood of a local population is very low as described in Appendix 2. ▪ This is not possible at Mamlambo -1 as the access track intersects 2 small areas of dune land type. Although there is an existing seismic line disturbance through the dunes, which will be used for the access road. ▪ This not possible at Dingo 1ST1 there is a mulga depression of low ecological value that will be intersected. This area has been previously disturbed by the original drill pad Dingo 1. ▪ Conservation significant flora and fauna habitat within 50 m of land disturbance areas to be noted as an exclusion area on maps and to be demarcated with bunting (administrative) ▪ Permit to work to specify area authorised to be cleared (administrative) ▪ Induction program to specify authorised area to be cleared (administrative) ▪ All personnel to receive induction program relevant to location (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.1 Clause A.3.5	Baseline ecology assessment has been performed by a suitably qualified person and the location of conservation significant flora and fauna habitat is known. Near threatened flora species are present within the Palm Valley-12. Given abundance of the flora species at the Palm Valley-12 well location, it is not possible to avoid. Suitably qualified person findings are that the removal of the individuals (<i>Stenanthemum Centrale</i>) from the Palm Valley-12 well location will not significantly affect the overall population status of the species. Dune land types (MW27-B and MW28-G) which potentially supports the Southern Marsupial Mole habitat are impacted by the development due to other constraints including topography, sub-surface target, and cultural heritage restrictions. A suitably qualified person findings describes the MW27 and MW28 locations to have low dunes and sand hills within the survey area that could be suitable habitat; however, they occur as small, isolated patches, and therefore are only marginally-suitable. There are few regional records (because of the paucity of large dune systems), which further indicates a very low likelihood of a local population. The disturbance of 0.07 Ha of dune land types in West Mereenie will have a negligible impact. Dingo 1ST1 lease pad impacts a Mulga depression Land type DG-C (Appendix 2). A suitably qualified person has assessed the area to have low ecological value and the suitably qualified person assessed the area to not require any Erosion Sediment Controls. In addition this area has been previously disturbed by the original Dingo 1 well and access track. Mamlambo 1 utilises existing land disturbance to minimise impacts. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		- Failure of storage tanks / sumps on well leases - Spills and leaks from chemical storage areas and chemical mixing areas on well leases - Spills and leaks from diesel storage on well leases	- Injury or death of native fauna - Loss of vegetation and fauna habitat	Moderate	Possible	Medium	- Implement Wastewater Management Plan (administrative) - Drilling fluid mud tanks will be surrounded by a drain that terminates in the lined, mud sumps (engineering) - Storage tanks engineered to meet relevant Australian Standards for integrity (engineering) - Chemical storage area bunded (engineering) - Diesel tank double bunded (engineering) - Undertake inspection of locations for leaks/spills and rectify where detected (administrative, engineering) - Ensure all fittings and equipment are checked and maintained (administrative, engineering) - Ensure that any spills, leaks or points of excessive wear are appropriately reported, and the necessary maintenance work and control measures undertaken (administrative, engineering) - Implement Spill Management Plan (administrative) - Implement Emergency Response Plan (administrative)	Effective	Moderate	Remote	Low	A (Low)	Clause A.3.8 Clause C.7.1 Clause C.7.2	The Wastewater Management Plan and Spill Management Plan address the requirements of the Code of Practice and have been developed by a suitably qualified person. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Introduction and / or spread of weeds	- Increased occurrence of weeds - Reduced native flora	Serious	Possible	High	- Implement Weed Management Plan (elimination, engineering, administrative) - All vehicles, equipment and machinery from known weed infested areas are to be cleaned and inspected for weeds prior to attending a site (engineering) - Vehicles to stay on designated tracks (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.1 Clause A.3.6	Baseline weed surveys have been undertaken. Buffel grass was the only weed detected during these surveys. The Weed Management Plan has been designed to prevent the spread of buffel grass and introduction of new weeds as part of the drill program. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Bushfire as a result of accidental ignition at site	▪ Injury or death of fauna ▪ Loss of vegetation and fauna habitat ▪ Destruction of infrastructure ▪	Serious	Possible	High	▪ Vegetation cleared from well leases and camps and stockpiled (engineering) ▪ Vegetation stockpiles (and other infrastructure) to have a 4 m fire break (engineering) ▪ Horizontal, inground flare system to be used (engineering) ▪ Flare pit design (20 x 12 x 2.5m) (engineering) ▪ Implement Bushfire Management Plan ▪ Designated smoking areas at each site (administrative) ▪ Fire-fighting equipment available at each site (PPE) ▪ Onsite personnel to be trained in use of fire-fighting equipment (administrative) ▪ Ignition sources to be kept outside designated hazardous area (administrative) ▪ Hazard areas to be included in onsite induction (administrative) ▪ Implement Emergency Response Plan (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.7	Fire-fighting controls are designed to deal with small scale fires at the infrastructure before they escalate to a larger bushfire. Firebreaks are as per the minimum requirements under the Bushfires Management Act 2016 The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.
	Reduction in conservation significant fauna species	Vegetation clearing / site preparation	▪ Injury or death of native fauna ▪ Loss of habitat	Minor	Likely	Medium	▪ Clearing occurs in a sequential manner to allow fauna to naturally escape (administrative) ▪ Land disturbance locations are designed to avoid land types that support conservation significant flora and fauna habitat (i.e. clay pans and dunes) (eliminate) ▪ This is not possible at MW27 and MW28 due to competing constraints The likelihood of a local population is very low as described in Appendix 2. ▪ In Palm Valley Slater Skink habitat is well known and will be demarcated to reduce impacts to the Slater Skink and Slater Skink habitat. (engineering). ▪ Avoid direct disturbance of gullies at Palm Valley-12 to minimise impacts to potential habitat (eliminate). ▪ Avoid or minimise disturbance of drainage feature land types. (engineering)	Effective	Minor	Possible	Low	A (Low)	Clause A.3.1 Clause A.3.5	Sequential clearing is a standard industry practice to allow fauna within the proposed clearing area to naturally escape. Dune land types (MW27-B and MW28-G) which potentially supports the Southern Marsupial Mole habitat are impacted by the development due to other constraints including topography, sub-surface target, and cultural heritage restrictions. A suitably qualified person findings describes the MW 27 and MW28 locations to have low dunes and sand hills within the survey area that could be suitable habitat; however, they occur as small, isolated patches, and therefore are only marginally-suitable. There are few regional records (because of the paucity of large dune systems), which further indicates a very low likelihood of a local population. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Vehicle collisions	Injury or death of native fauna	Minor	Likely	Medium	- Limit speed on unsealed CP controlled access roads to 60 km/hr (administrative) - Report all vehicle interactions with fauna (administrative)	Effective	Minor	Possible	Low	A (Low)	Clause A.3.5	Speed is limited to maintain a balance between ability to perform activities and protecting fauna from vehicle strikes. CP's experience is that this speed is adequate to control the event. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Fauna trapped in tanks, sumps, open pipework		Minor	Likely	Medium	- Tanks walls are vertical to prevent fauna access (engineering) - Site manned during operation (administrative) - Sumps temporarily fenced to prevent stock and wildlife access (engineering) - Open pipework to be checked before use for trapped fauna (administrative)	Effective	Minor	Possible	Low	A (Low)	Clause A.3.5	The risk mitigation measures are standard practice across CP's activities in the NT and are designed to either prevent or identify and remove fauna before they are injured or killed whilst at the well location. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
		Encouragement of pest species which compete with native fauna	- Injury or death of native fauna - Increased pest species	Minor	Likely	Medium	- Suitable waste containers for waste storage are to be available at each location (engineering) - Waste containers to be fauna and vermin proof (engineering) - Each facility is maintained free of rubbish outside waste disposal receptacles (administrative) - Wastes to be removed from site by a suitably licensed person and disposed at an appropriately licensed facility	Effective	Minor	Possible	Low	A (Low)	Clause A.3.5	The risk mitigation measures are standard practice across CP's activities in the NT and are designed to prevent the encouragement of pest species at the well locations or camps. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Bushfire as a result of accidental ignition at site	▪ Injury or death of fauna ▪ Loss of vegetation and fauna habitat ▪ Destruction of infrastructure	Serious	Possible	High	▪ Vegetation cleared from well leases and camps and stockpiled (engineering) ▪ Vegetation stockpiles (and other infrastructure) to have a 4 m fire break (engineering) ▪ Horizontal, inground flare system to be used (engineering) ▪ Flare pit design (20 x 12 x 2.5m) (engineering) ▪ Implement Bushfire Management Plan ▪ Designated smoking areas at each site (administrative) ▪ Fire-fighting equipment available at each site (PPE) ▪ Onsite personnel to be trained in use of fire-fighting equipment (administrative) ▪ Ignition sources to be kept outside designated hazardous area (administrative) ▪ Hazard areas to be included in onsite induction (administrative) ▪ Implement Emergency Response Plan (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.7	Fire-fighting controls are designed to deal with small scale fires before they escalate to a larger bushfire. Firebreaks are as per the minimum requirements under the <i>Bushfires Management Act 2016</i> The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.
Cultural heritage / sacred sites	Unauthorised disturbance to sacred sites or culturally sensitive sites	Sites not previously identified during baseline assessments Works undertaken within exclusion areas	▪ Disturbance to cultural heritage / sacred sites ▪ Loss or destruction of cultural heritage / sacred sites	Serious	Possible	High	▪ AAPA and CLC certificates obtained for drilling program (administrative) ▪ Exclusion areas to be established around known finds (as per Everick Heritage report, <i>Central Petroleum Drilling Program 2020: Aboriginal Archaeological Assessment</i>) (engineering) ▪ Implement Aboriginal Object Find / Stop Work Procedure for unexpected finds (as per Everick Heritage report, <i>Central Petroleum Drilling Program 2020: Aboriginal Archaeological Assessment</i>) (administrative) ▪ All site personnel to receive induction program which includes locations of exclusion areas and Aboriginal Object Find / Stop Work Procedure (administrative)	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.1	Baseline assessments have been undertaken by a suitably qualified person. Risk mitigation measures have been developed that address both known and unknown finds. The necessary authorisations under NT legislation have been obtained. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
People and Community	Loss of visual amenity	Industrialisation of the landscape Light emissions (flaring and safety lighting)	- Local community and landowner complaints - Disruption to surrounding stakeholder's regular activities	Minor	Possible	Low	- Sites are located away from major roads and infrastructure is not visible from the major road - Nearest homestead / Aboriginal Community is located approximately 8km (Palm Valley-12 location (Hermannsburg)) - Well lease and camp disturbance footprints are the minimum whilst still meeting health and safety requirements - Local community alerted to flaring period by community engagement, provision of notices on public notice boards and notifications in the local paper	Effective	Minor	Unlikely	Low	A (Low)	Clause A.3.1 Clause A.3.2	Well locations are not visible from major roads. It is possible that during flaring at night, the community will see the hue of the flare, which will only occur during testing of each well. For previous CP drilling campaigns, alerting the community via notifications on public notice boards has been utilised. Any perceived loss of amenity would be limited to the duration of well testing. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Vehicle accidents	Increased traffic on local roads as a result of drilling program	- Local community and landowner complaints - Disruption to surrounding stakeholder's regular activities	Minor	Possible	Low	- Engage with relevant NT government departments in the development of the Traffic Management Plan (eg. Tourism NT) - DIPL approved Traffic Management Plan to be in place prior to commencing activities (administrative) - Transportation of over-width or over-dimension loads conducted in accordance with Department of Transport permit (administrative) - On unsealed roads if dust is created reduce speed (administrative) - Well lease access tracks signed to prevent unauthorised access (administrative) - All turn off and turns onto NT controlled roads are suitable for petroleum activities (engineering) - Personnel manage journey in accordance with a journey management plan (administrative) - CP has paramedics, an ambulance on site and field hospital facilities (administrative) - Zero alcohol and/or drugs policy with routine testing undertaken (administrative)	Effective	Minor	Unlikely	Low	A (Low)	Clause A.3.1	Traffic Management Plan requires approval from the DIPL Other permits as necessary will be obtained prior to transporting loads. Both these measures are the mandatory requirements under NT legislation. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
	Reduction in productivity of the land	Introduction and spread of weeds Disturbed land not returned to pre disturbance land use capability	- Failed rehabilitation - Landowner complaints - Additional costs to remediate	Serious	Possible	High	- Implement Weed Management Plan - All vehicles, equipment and machinery from known weed infested areas are to be cleaned and inspected for weeds prior to attending a site (engineering) - Implement Rehabilitation Plan	Effective	Serious	Remote	Medium	A (Low)	Clause A.3.6 Clause A.3.9	The Weed Management Plan and Rehabilitation Management Plan have been developed by a suitably qualified person and is designed to ensure that at the completion of activities the land is returned to its pre disturbance land use capability These plans contain what would be considered standard practices in the NT for weed management and rehabilitation. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.
	Unnecessary disruption to landholder activities	Not undertaking activities in accordance with land access agreements	- Landowner complaints - Delays to program	Minor	Possible	Low	- Induction program to include information on authorised activities for a site - All personnel to receive induction program relevant to the site they are accessing	Effective	Minor	Unlikely	Low	A (Low)	NA	Induction programs are designed to instil the specific requirements for each well location to all personnel who attend the location. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
	Increased noise due to drilling activities	Location of well sites	Local community complaints	Minor	Possible	Low	- Nearest homestead / Aboriginal Community is located approximately 8km (Palm Valley-12 location) - Drilling noise impact assessment shows no impacts on sensitive receptors	Effective	Minor	Unlikely	Low	A (Low)	Clause 3.1.1 Clause A.3.3	The location of the wells is the primary control. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.
Greenhouse Gas Emissions	Greenhouse gas emissions from the activity	Combustion of diesel during activities	Contribution to greenhouse gas emissions	Minor	Frequent	Medium	- All diesel used onsite is to be compliant with the Federal Government's <i>Fuel Quality Standards (Automotive Diesel) Determination 2019</i> - All equipment / machinery to be maintained in accordance with manufacturer specifications	Effective	Minor	possible	Low	A (Low)	Clause A.3.1	Greenhouse gas emissions will be released as the drilling program relies upon fossil fuels for combustion. Diesel fuel which has a lower greenhouse gas contribution than petrol is used in all vehicles and the drill rig which account for the majority of fuel usage. Small equipment may still use petrol engines. The residual risk has been reduced to the greatest extent possible due to the likelihood rating remaining as likely (the only way to reduce this further would be to not use fossil fuels). Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
		Venting of gas during drilling / well testing		Minor	Frequent	Medium	No venting of gas a flare will be used during drilling and well testing (engineering)	Effective	Minor	Remote	Low	A (Low)	Clause D.5.9	Flaring results in less greenhouse gas emissions compared to venting. Capture of any gas during the well testing phase is not practical given the relatively short period of testing and commercial quantity of the captured gas. Once sufficient information has been obtained during testing the well will either be completed, cased and suspended or decommissioned. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4, with no further risk reduction warranted.
		Leakage of gas from wells		Minor	Likely	Medium	- Well design includes multiple steel casing and cement barriers between hydrocarbon bearing zone and surface (engineering) - Well design and barrier integrity validation reports submitted to DITT as part of WOMP (administrative) - Routine well integrity and well barrier verification processes in place for the entire life of the well (engineering) - As part of the DITT approved WOMP an inspection criteria will be defined (administrative) - Methane emission detection to be undertaken in accordance with the Methane Emission Management Plan (administrative, engineering) - Well decommissioning / case and suspended includes multiple steel casing and cement barriers between hydrocarbon bearing zone and surface (engineering)	Effective	Minor	Remote	Low	A (Low)	Clause B.4.1 Clause B.4.3 Clause D.5	Construction of each of the wells is undertaken in accordance with the Code of Practice which is the industry requirement in the NT. Multiple barriers have been installed across aquifers to ensure isolation. Cement bond logs and pressure testing of each of the strings will occur to confirm that control measures have met design requirements. Based upon the risk being ranked as a low, the controls being assessed as effective and a scientific uncertainty score outcome of low, the risk is determined to be ALARP and 'acceptable' in accordance with the rationale provided in Section 6.4, with no further risk reduction possible.

Environmental Aspect	Potential impact	Causes	Consequence	Inherent Risk			Risk Mitigation Measures (Hierarchy Type)	Controls Rating	Residual Risk			Uncertainty Level	Code of Practice	ALARP Rationale
				C	L	R			C	L	R			
Rehabilitation	Rehabilitation is not successful on completion of activities or as required by approval.	Ineffective rehabilitation planning and execution. Lack of rain / soil moisture to enable revegetation	- Erosion, - Degradation of downstream water quality from sediment releases. - Loss of topsoil. - Land suitability changes. - Land degradation. - Reduction in agricultural productivity	Minor	Possible	Low	- Implement Rehabilitation Plan - Seeding will be completed prior to the wet season to get the best possible germination and vegetation establishment. - An ESCP will be developed specific to the rehabilitation program to minimise this risk. - The soils are to be returned to pre-disturbance soil profiles and topsoil spread over the entire lease evenly. Topsoil may need to be brought in if there is a lack of topsoil. - CP will monitor and manage weeds with the weed management plan to minimise the risk of weed impacts. - The rehabilitation area will be fenced to limit impacts from grazing.	Effective	Minor	Unlikely	Low	A (Low)	Clause A.3.6 Clause A.3.9	The Rehabilitation Management Plan has been developed by a suitably qualified person and is designed to ensure that at the completion of activities the land is returned to its pre disturbance land use capability These plans contain what would be considered standard practices in the NT for weed management and rehabilitation. The residual risk has been reduced to the greatest extent possible due to the consequence remaining as serious if an event did occur. Therefore, we consider this risk ALARP and acceptable in accordance with the rationale provided in Section 6.4,

6.8 Risk Summary

Table 6-6 shows the number of inherent risks identified to environmental aspects associated with the activities under this EMP. Inherent risk refers to amount of risk associated with an event assuming the absence or failure of controls. The count of inherent risks is assessed with the assumption of no control measures are in place.

Table 6-7 provides a count of the residual risks associated with activities under this EMP with appropriate controls implemented. This summary indicates that the controls are effective and risks have been successfully managed to ALARP and are acceptable.

Table 6-6 Count of unmitigated risks

Unmitigated Risks				
Risk Level	Low	Medium	High	Very High
Count	6	27	11	0

Table 6-7 Count of residual risks

Residual Risk				
Risk Level	Low	Medium	High	Very High
Count	34	10	0	0

6.9 Cumulative Assessment

A review of cumulative impacts associated with the proposed drilling campaign is summarised Table 6-8.

Other industries or places that are located in close proximity to areas of the CP drilling program that have been reviewed include:

- Agriculture,
- Tourism, and
- Communities.

In general, the drilling wells represent a single well in an area and as such represent the cumulative impact within the localised area of the well – the risk assessment within this EMP therefore considers the cumulative impact of these wells.

The development wells represent a contribution to existing gas field developments (Mereenie, Palm Valley and Dingo) and it is the intention that upon completion of activities under this EMP the ongoing operation is transferred to their respective field EMP. As such, these development wells provide a potential cumulative impact to their respective operating fields. The risk assessments for the Mereenie, Palm Valley and Dingo Fields has been reviewed and no changes to the risks for these fields are required from a cumulative impact as a result of the potential addition of the development wells. Where CP becomes aware that other activities are likely to contribute to a greater cumulative impact it will undertake a review of its risk assessment.

Table 6-8 Summary of Cumulative Impacts

Aspect	Summary
Groundwater	▪ For Palm Valley 12, Dingo 1, Dingo 5 and Orange 3 commercial agreements for water will be required and therefore no cumulative impacts to groundwater.

Aspect	Summary																					
	- For Mereenie 27 and 28 drilling campaigns water will be accessed from, Bore – RN018955, Bore – RN017657, Bore – RN017898, Bore – RN004620 and Bore –RN013861. The current estimated water use in the area is 34-47 ML/year. It is anticipated water required for both wells is 1.1ML over 34 days. The drawdown will not exceed 0.1 m beyond a distance of approximately 200m from the extraction bore. The closest bore that is in use is approximately 10km for the Mereenie Field. Therefore, very unlikely for cumulative impacts. - Water for the Mamlambo-1 well will be taken from bore RN018851. There is currently no water take from this bore. The Mamlambo-1 drilling program is estimated to require roughly 1.4 ML of water over the entire duration (40 days). The analysis indicates that drawdown will be effectively unmeasurable beyond approximately 100m of the extraction bore. Therefore, very unlikely for cumulative impacts.																					
Flora and Fauna	The drilling disturbance footprint for each proposed well location is <10ha. The location of the wells have been assessed through a multi-criteria analysis and have been located to avoid or minimise impacts to flora, fauna habitat and sensitive landforms. Where possible CP has located infrastructure in previously cleared locations to reduce the cumulative impacts.																					
Land	The disturbance area will have minimal impact on the existing land use or contribute to cumulative disturbance from other potential activities. The following is the % disturbance of the tenure:<table><tr><th>Indicative well lease</th><th>Permit</th><th>Percentage of tenure disturbed</th></tr><tr><td>Dingo 1 ST1*</td><td rowspan="2">L7</td><td rowspan="2">0.01%</td></tr><tr><td>Dingo 5</td></tr><tr><td>Mamlambo 1</td><td>L6</td><td>0.005%</td></tr><tr><td>Orange 3</td><td>EP82</td><td>0.0003%</td></tr><tr><td>Palm Valley 12</td><td>OL3</td><td>0.004%</td></tr><tr><td>West Mereenie 27</td><td>OL4</td><td rowspan="2">0.07%</td></tr><tr><td>West Mereenie 28</td><td>OL4</td></tr></table> *re-use of previous disturbance area	Indicative well lease	Permit	Percentage of tenure disturbed	Dingo 1 ST1*	L7	0.01%	Dingo 5	Mamlambo 1	L6	0.005%	Orange 3	EP82	0.0003%	Palm Valley 12	OL3	0.004%	West Mereenie 27	OL4	0.07%	West Mereenie 28	OL4
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Palm Valley 12	OL3	0.004%																				
West Mereenie 27	OL4	0.07%																				
West Mereenie 28	OL4																					

Aspect	Summary																																
Greenhouse Gases	The total greenhouse gas (GHG) emissions generated from activities under this EMP are anticipated to be approximately 91,324.59 tCO₂-e (tonnes of carbon dioxide equivalent) for the mobilisation, construction of leases, drilling and flaring. This equates to an average of 18,264.92 tCO₂-e per year over five years. On an annual basis, GHG emissions for the drilling program are around 33% of CP’s total annual GHG emissions for the operation of the existing CP oil and gas fields in the area (54,742 tCO₂–e from Dingo Gas Field, Mereenie Oil and Gas Field and Palm Valley Gas Field). However, the majority of the emissions for the drilling program are generated from gas flaring (maximum case scenario), which is restricted to the drilling program and is not an activity typically conducted during the operation of a well. Overall, the total emissions from the drilling program represents approximately 0.11% of the total estimated annual GHG emissions for the NT (16 million tCO₂-e for 2018, Department of Industry, Science, Energy and Resources, May 2020). The drilling program has relatively short duration, it will be a small increase in CPs total GHG emissions and an insignificant emission compared to the overall GHG emissions of the NT, the cumulative impact of CP emissions is considered low. The primary greenhouse emission sources from activities are the exhaust from internal combustion (IC) engines used in lease preparation and drilling operations; land/vegetation clearing; the flaring of gas associated with drilling, well testing and completions; and mobile source emissions associated with equipment used at the well site and to transport personnel and equipment to/from the site (API, 2009). Fugitive emissions may released from the drill cuttings which will be estimated at the time as per Table 7-9 in the Methane Emissions Management Plan. Activity Data A summary of the activity data and assumptions used in the calculations is provided below. To estimate the associated diesel usage for the civil works on a per lease basis, data collected from previous CP activities has been utilised as per the table below. <table><tr><th>Equipment</th><th>L/day</th><th>Total days</th><th>Diesel Usage (L)</th></tr><tr><td>2 Crew Vehicles (4 x Trips to camp/day at 20km/trip) Assume 10l/100km</td><td>38.4</td><td>21</td><td>806.4</td></tr><tr><td>Water Trucks x 2 Operating for 8H/day - Assumes (26.6l/100km or 22 l/hr working)</td><td>352</td><td>15.75</td><td>5544</td></tr><tr><td>1 x Caterpillar D8 Dozer - working on average for 8 hours at Medium duty 32l/hr</td><td>256</td><td>15.75</td><td>4032</td></tr><tr><td>1 x Caterpillar D7 Dozer - working on average for 8 hours at Medium duty 20.8l/hr</td><td>166.4</td><td>15.75</td><td>2620.8</td></tr><tr><td>1 x 623G Scraper Caterpillar - working on average for 4 hours at Medium duty est 40l/hr</td><td>160</td><td>15.75</td><td>2520</td></tr><tr><td>Caterpillar Excavator (40l/hr / 8 hr) - Est</td><td>320</td><td>15.75</td><td>5040</td></tr><tr><td colspan="3">Total</td><td>20,563</td></tr></table>	Equipment	L/day	Total days	Diesel Usage (L)	2 Crew Vehicles (4 x Trips to camp/day at 20km/trip) Assume 10l/100km	38.4	21	806.4	Water Trucks x 2 Operating for 8H/day - Assumes (26.6l/100km or 22 l/hr working)	352	15.75	5544	1 x Caterpillar D8 Dozer - working on average for 8 hours at Medium duty 32l/hr	256	15.75	4032	1 x Caterpillar D7 Dozer - working on average for 8 hours at Medium duty 20.8l/hr	166.4	15.75	2620.8	1 x 623G Scraper Caterpillar - working on average for 4 hours at Medium duty est 40l/hr	160	15.75	2520	Caterpillar Excavator (40l/hr / 8 hr) - Est	320	15.75	5040	Total			20,563
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Total			20,563																														

Aspect	Summary																																																						
	A summary of the estimated diesel usage and CO₂ emissions per lease and the total emissions for the project is provided below. <table><tr><th>Diesel usage per lease (L)</th><th>Approximate tCO₂-e ^ per lease</th><th>Number of leases</th><th>Total approximate tCO₂-e ^</th></tr><tr><td>20,563 (per lease)</td><td>55.1</td><td>7</td><td>386</td></tr></table> A summary of the estimated diesel usage and CO₂ emissions from the five-year drilling program is provided below. The drilling program is anticipated to be 301 cumulative days. <table><tr><th>Well</th><th>Planned activity days</th><th>Diesel Usage</th><th>Approximate tCO₂-e ^</th></tr><tr><td>Palm Valley 12</td><td>86</td><td>304,500</td><td>816</td></tr><tr><td>Orange 3</td><td>62</td><td>220,500</td><td>591</td></tr><tr><td>Dingo 1 ST1</td><td>45</td><td>157,500</td><td>422</td></tr><tr><td>Dingo 5</td><td>64</td><td>227,500</td><td>610</td></tr><tr><td>Mamlambo 1</td><td>28</td><td>42,000</td><td>113</td></tr><tr><td>West Mereenie 27</td><td>30</td><td>101,500</td><td>272</td></tr><tr><td>West Mereenie 28</td><td>30</td><td>101,500</td><td>272</td></tr><tr><td>Total</td><td>301</td><td>1,155,000</td><td>3095</td></tr></table> A summary of the emissions from land clearing is provided below. <table><tr><th>Activity</th><th>Total area (ha)</th><th>Vegetation Class</th><th>Emissions Factor (tCO₂-e /ha)</th><th>Total Approximate tCO₂-e</th></tr><tr><td>Land Clearing</td><td>25.71</td><td>Open Shrubland (G) – Acacia Shrubland</td><td>113</td><td>2905.23</td></tr></table> Emissions were calculated using the Transport Authorities Greenhouse Group (TAGG) GHG Assessment Workbook for Road Projects (2013). The TAGG workbook Appendix E provides a methodology for estimating the loss of carbon sequestration that exists in vegetation at the time of clearing and the potential carbon that could have been sequestered in the future if the vegetation was not cleared. The methodology is consistent with that used by the Australian Government to estimate Australia’s national GHG emissions for reporting under the United Nations Framework Convention of Climate Change. The methodology makes conservative assumptions that all carbon pools are removed as part of the clearance of vegetation (e.g. soil and debris) and that all carbon removed is converted to CO₂. Using the land types described in Section 5 of this EMP and Table 1 of Appendix E of the TAGG workbook, CP has conservatively assumed that all vegetation to be cleared for the drilling program is vegetation class G (Open Shrubland – Acacia Shrubland), which has a higher emissions factor than other vegetation classes found in the proposed disturbance area such as class F (Mallee and Acacia Woodland and Shrubland - Acacia Open Woodlands) (106 tCO₂-e) and class I (Grassland - Tussock Grasslands) (110 tCO₂-e).	Diesel usage per lease (L)	Approximate tCO ₂ -e ^ per lease	Number of leases	Total approximate tCO ₂ -e ^	20,563 (per lease)	55.1	7	386	Well	Planned activity days	Diesel Usage	Approximate tCO ₂ -e ^	Palm Valley 12	86	304,500	816	Orange 3	62	220,500	591	Dingo 1 ST1	45	157,500	422	Dingo 5	64	227,500	610	Mamlambo 1	28	42,000	113	West Mereenie 27	30	101,500	272	West Mereenie 28	30	101,500	272	Total	301	1,155,000	3095	Activity	Total area (ha)	Vegetation Class	Emissions Factor (tCO ₂ -e /ha)	Total Approximate tCO ₂ -e	Land Clearing	25.71	Open Shrubland (G) – Acacia Shrubland	113	2905.23
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Aspect	Summary																		
	A summary of the estimated cumulative CO₂ emissions from flaring (maximum -case flaring) is provided below. As per Table 4-3 of this EMP, flaring is to occur over 68.7 days during the 5 year drilling program. <table><tr><th>Volume of gas flared (Bcf)</th><th>Emission</th><th>Emissions Factor (tCO₂-e/t gas flared)</th><th>Approximate tCO₂-e</th></tr><tr><td rowspan="3">1.076</td><td>CO₂</td><td>2.8</td><td>63,268.80</td></tr><tr><td>CH₄</td><td>0.933</td><td>21,082.07</td></tr><tr><td>N₂O</td><td>0.026</td><td>587.50</td></tr><tr><td colspan="2"></td><td>Total</td><td>84,938.36</td></tr></table> Flaring tCO₂-e emissions have been estimated using the forecasted gas flare volumes shown in Table 4-3 multiplied by emissions factors from Section 3.44 Method 1- oil and gas exploration (flared) emissions in the <i>National Greenhouse and Energy Reporting (Measurement) Determination 2008</i>.	Volume of gas flared (Bcf)	Emission	Emissions Factor (tCO ₂ -e/t gas flared)	Approximate tCO ₂ -e	1.076	CO ₂	2.8	63,268.80	CH ₄	0.933	21,082.07	N ₂ O	0.026	587.50			Total	84,938.36
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	N ₂ O	0.026	587.50																
		Total	84,938.36																
Traffic	▪ The anticipated peak project vehicle movement level is <20 vehicles/day in addition to the existing peak dry season traffic volumes. ▪ The total volume of traffic is considered lower than the capacity of the Stuart Highway, Larapinta Drive and Maryvale Road, with any reduction in LOS from the volume of project traffic considered unlikely.																		
Social	▪ Risk associated with increased competition for labour from drilling activities, including other industries, is low due to specialised drilling crews being brought in. Civil and commissioning activities for the project is well within the capacity of existing service providers. ▪ A change in landscape resulting in a loss of amenity and tourism value is considered low due to limited extend of CP petroleum activities, the isolated location of the wells and no other petroleum or mining projects in the area.																		
Rehabilitation	▪ Successful rehabilitation is dependent on the vegetation type, soil type and moisture content in the soil which, in turn, is dependent on the timing and amount of rainfall in the region after earth work restoration commences. ▪ CP ensures that the least amount of disturbance is undertaken that enables the safe delivery of the project scope which minimises the total rehabilitation requirements. ▪ CP undertakes progressive stabilisation of disturbance after activities are finalise and blends wellsites and associated access tracks into the surrounding contours and ensures soil colour and material is returned to a level compatible with that of the surrounds. His process ensures the most likely success of rehabilitation over the long term.																		

7.0 Management Plans

7.1 Erosion and Sediment Control Plan

The Code of Practice requires an erosion and sediment control plan (ESCP) for the activities to be developed by a suitable qualified person in accordance with the relevant guidelines including specific environmental outcomes and environmental performance standards included in the Implementation Strategy in the EMP.

The project specific ESCP is provided in Appendix 5 and has been developed in accordance with the following documents:

- Code of Practice
- Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008)
- NT EPA Erosion and Sediment Control Plan Content (formally NRETAS, 2006)
- Land Clearing Guidelines (DEPWS, 2019)
- Erosion and Sediment Control Guidelines for Rural Development Environment Fact Sheet (Department of Land and Resource Management, 2018).

7.2 Weed Management Plan

The Code of Practice requires a weed management plan that is developed in accordance with the requirements of the *NT Weed Management Planning Guide: Onshore Petroleum Projects* and also provides for the following:

- Baseline weed assessments and prior to regulated activities being undertaken
- Ongoing weed monitoring
- Provision of a dedicated weeds officer
- Consistency with statutory requirements including any relevant threat abatement plans under the EPBC Act.

The project specific weed management plan is provided in Appendix 6.

7.3 Bushfire Management Plan

The Code of Practice requires a fire management plan that demonstrates the following:

- Analysis of baseline fire information (minimum 10 years)
- Analysis of the impacts of the proposed activities on the existing fire management regime
- Coordination with the landholder and other land users and consistency with the landholder's fire management obligations and strategies
- Implementation of appropriate fire mitigation measures
- Appropriate fire control measures
- Annual fire mapping
- Annual monitoring of fuel loads.

The bushfire management plan for the project is provided in Appendix 7 and has been based on the DEPWS's recently released *Bushfire Management Planning Guide: Onshore Petroleum Projects*.

7.4 Wastewater Management Plan

The Code of Practice requires a wastewater management plan be included with the EMP that addresses all water and wastewater management activities that are defined within the Code of Practice.

Wastewater is defined in the Code of Practice as:

- Water that has been used in or produced from petroleum wells, whether it is being re-used, recycled, treated, or disposed of, and includes flowback fluid, produced water, drilling fluids, completion fluids, well suspension fluids and non-aqueous drilling fluids
- Waste material and material containing contaminants as defined in s 117AAB of the Act
- Wastewater meeting the definition of waste under the Waste Management and Pollution Control Act 1998 (NT)
- Water that has been acquired or used in petroleum activities that is being disposed of
- Residual drilling waste, e.g. muds and cuttings (which may be more or less in a solid state) in addition to the fluids mentioned above.

The wastewater management plan is required to include the following:

- Description of activities that will generate waste and wastewater
- Characteristics of the anticipated wastewater streams (including quantity and quality of each)
- Risk assessment in relation to the potential impact to the environment from water and wastewater
- Proposed method of water and wastewater storage, transportation, treatment, disposal, and reuse as part of the proposed activities
- Strategies to minimise or reduce the volume of wastewater that will be disposed offsite
- Expected quantity and quality of water and wastewater that will be treated and reused
- Estimates of the 1:1000 average rainfall interval (ARI) rainfall rate using the Australian Rainfall and Runoff methodologies for the critical period during which there would be the greatest risk of overtopping of any structures holding wastewater which are not enclosed.

7.4.1 Wastewater Management Framework

The Code of Practice establishes the following wastewater management framework, which CP has designed their wastewater management in accordance with:

- Estimate the quantities and qualities of water and wastewater from the petroleum activities
- Define the methods and approaches that are used to store, treat, reuse and dispose of wastewater
- Estimate the quantities and quality of wastewater (including derived solids) that will be removed from the site
- Based on the above include the environmental risks, impacts and mitigation in a wastewater management plan
- Monitor, manage and report on the above.

7.4.2 Wastewater Generated

Based on the activities proposed to be undertaken as part of this EMP, drilling fluids³⁹, residual drilling waste (cuttings), completion fluids and flowline hydrotest water are likely to be the wastewater produced.

Drilling fluids are used during the drilling of the well to:

³⁹ The term mud is frequently used interchangeably with the term fluid because of the thick consistency of the fluid

- Carry cuttings from the hole
- Cool and clean the drill bit
- Reduce friction
- Maintain the stability of the bore
- Maintain down-hole hydrostatic pressure to prevent formation flow while drilling
- Prevent damage to the formation.

The drilling fluid system will be a contained system and consist of engineered fluid storage tanks on the well lease. Drilling fluids are recirculated through the mud system on the drill rig during drilling operation. Drilling muds will be formulated in-situ by mixing the different additives with water in a dedicated aboveground storage tank.

As described in Section 4.0, each of the wells will be drilled using a combination of air/mist and water-based mud fluid systems. Whilst undertaking air/mist drilling the drilling fluid and cuttings are discharged into the flare pit (via the blooie line). Once flaring commences the majority of liquid within the flare pit is vaporised. This residual drilling waste is then transferred manually to the lined sump.

When a water-based mud system is used, drill fluids are separated from cuttings via the use of shakers. The returned drilling fluid flows over shale shakers to separate the cuttings from the drilling mud, with cuttings ejected into a skip for transferal into the cuttings pit and the drill fluid flows through the sieves and is cycled back to the mud tanks. The cuttings are sampled as they drop off the shale shakers at specified intervals for processing and analysis by the mudlogging team and wellsite geologist.

Completion fluids are used when converting the well from drilling to production. The fluids are discharged from the well into the lined sump.

Hydrotest water is required to pressure test the flowlines to confirm the flowline integrity prior to it being used as part of development activities.

7.4.3 Water / Wastewater Storage

Figure 4-7 shows the layout of the well lease and water / wastewater storage that may be used during the drilling campaign. Storages are as follows:

- Water storage sump – storage of water from either commercial suppliers or groundwater bores (likely to be non-potable) and will be the water source for the drilling fluid, completion fluid and hydrotesting the flowlines
- Drilling sump – used for the storage of residual drill fluid / cuttings and completion fluid
- Flare pit - used for the temporary storage of drill fluids / cuttings used during air/mist drilling
- Storage / mixing tanks – used for storage of the drill fluids and completion fluids ready for use in the drilling process.

Section 4.8.4 provides an overview of the wastes that are likely to be generated during the drilling campaign.

7.4.4 Estimated Wastewater Quality and Quantity

Table 7-1 provides an overview of the estimated wastewater quantity and quality for each of the well locations.

Table 7-1 Estimated Wastewater Quality and Quantity

location	Wastewater Type	Estimated Quantity (ML) ⁴⁰	Expected Quality
Dingo-1 ST1	Drill fluid / cuttings (sump)	0.15	

⁴⁰ Includes the quantity transferred from the flare pit

location	Wastewater Type	Estimated Quantity (ML) ⁴⁰	Expected Quality
	Completion fluids	0.5	<u>Drill Fluid / Residual Drilling Waste / Completion fluids</u> pH range 6-10.5 EC < 20,000 µS/cm Chloride < 8,000 mg/L Metals - As per NEPM 2013 <u>Hydrotest Water</u> As per source water quality
	Hydrotest	0.1	
Dingo-5	Drill fluid / residual drilling waste (sump)	0.15	
	Completion fluids	0.5	
	Hydrotest	0.1	
Orange-3	Drill fluid / residual drilling waste (sump)	0.15	
Palm Valley-12	Drill fluid / residual drilling waste (sump)	0.18	
	Completion fluids	0.5	
	Hydrotest	0.1	
West Mereenie-27	Drill fluid / residual drilling waste (sump)	0.075	
	Completion fluids	0.5	
	Hydrotest	0.1	
West Mereenie-28	Drill fluid / residual drilling waste (sump)	0.075	
	Completion fluids	0.5	
	Hydrotest	0.1	
Mamlambo-1	Drill fluid / residual drilling waste (sump)	0.06	

7.4.5 Management Hierarchy

Wastewater will be managed with the objective of minimising off-site disposal and in accordance with the following hierarchy principles:

- Avoid – eliminate or substitute an activity that results in wastewater
- Reduce – reduce unnecessary resource use or substitute a less resource intensive product or service
- Re-use – reuse a waste without further processing
- Recycle – recover resources from a waste
- Treat – treat the waste to reduce the hazard of the waste prior to disposal
- Dispose – disposal of waste if there is no viable alternative

Table 7-2 provides a summary assessment of the application of the waste management hierarchy in regard to wastewater.

Table 7-2 Wastewater Management Hierarchy Assessment

Wastewater	Avoid	Reduce	Reuse	Recycle	Treat	Dispose
Drill Fluid	Non aqueous drilling mud will not be used. Air / mist drilling also to be performed	Recycle fluids as much as possible - reduces consumption of additives and production of waste	Transfer recycled fluids between wells where applicable. Treat fluid to avoid bacteria and prolong operational lifespan	Recycle fluids as much as feasible with available solids control equipment	Not possible	At the end of the campaign, drilling fluids will be evaporated in the sump and mix buried covered provided it meets the criteria for burial
Cuttings	Not possible	Mud weights designed for gauge wellbore. This will minimise excess cuttings	Not possible	Not possible	Separate fluids from cuttings as much as possible to maximise recycling of fluid	Onsite cuttings burial or removal from site subject to sampling results.
Completion Fluid	Not possible	Volumes required are the minimum to safely allow the completion to proceed	Not possible	Not possible	Not possible	At the end of the campaign, completion fluids will be evaporated in the sump and mix buried covered provided it meets the criteria for burial
Hydrotest Water	Not possible	Volumes required for the test are the minimum to allow the test to be performed	At completion of the hydrotest, hydrotest water will be tested prior to use for irrigation for progressive rehabilitation or dust suppression	Not possible	Not possible	If hydrotest water is not suitable for irrigation or dust suppression or not needed it will be either: ▪ evaporated in the flare pit or ▪ the evaporation ponds at Mereenie and Palm Valley Fields will be used to dispose the hydrotest water

7.4.6 Rainfall Characteristics

The Code of Practice requires an estimate of the 1 in 1000 ARI rainfall rate ⁴¹using Australian Rainfall methodologies (Australian Rainfall and Runoff, 2019) for the critical period during results in the highest risk of overtopping.

To address this requirement, the sumps will be designed to contain the volume of the 1:1000 ARI 72hr rainfall event. The 1 in 1000 (0.1%) year AEP for a 72 hour rainfall event for the proposed drilling locations is displayed in Table 7-3 . The inlet structure to the sump will be designed to convey the 1:1000 ARI 1hr event to allow intense peak discharge to enter the structure without overflow.

Table 7-3 The 1 in 1000 (0.1%) Year AEP for Rainfall at the Proposed Locations

Location	0.1% AEP Rainfall	Rainfall (mm)
Dingo	72hr	473
Orange		482
Mereenie		470
Palm Valley		453
Mamlambo		447

The 1:1000 ARI event has a 0.1% chance of occurring or being exceeded in any one year. Therefore, the annual risk of discharge from the sump for the design event is 0.1%.

As the drilling campaign is likely to be undertaken in the wet season and the sumps are likely to remain open over multiple wet seasons, CP will ensure that the sumps are designed to cater for the 1:1000 ARI rainfall event.

7.4.7 Wastewater Sump Water Balance

The Code of Practice requires an estimate of the 1 in 1000 ARI (0.1% AEP) rainfall rate using Australian Rainfall methodologies (Australian Rainfall and Runoff, 2019) for the critical period which results in the highest risk of overtopping. To address this requirement, the sumps will be designed to contain the volume of the 1:1000 ARI (0.1% AEP) 72hr rainfall event. The sumps will be bunded to prevent external catchments from contributing to the stored volume.

A review of the Intensity-Frequency-Duration curves for the proposed well sites showed some spatial variance in rainfall depths, however all sites were between 440-475mm of rainfall depth for the 1:1000 72hr event. A conservative estimate of 500mm was adopted for all sites. In addition to rainwater, the sump also collects wastewater from the drilling process. The wastewater generated from each well site is up to 0.8ML, as outlined in Table 7-1 and Table 7-2 of the EMP. For the purposes of the water balance, it has been assumed that 0.8ML of capacity is required initially, and an additional 0.002ML (0.8ML /365.25 days) of wastewater is generated on a daily basis. This is considered to be a conservative assessment.

Therefore, it has been determined that a sump volume of 1.3ML is required. This is the worst-case scenario in that it assumes that all wastewater has been generated and disposed of in the sump, and a 1:1000 AEP 72hr rainfall event occurs. In reality, as noted above, some of the wastewater will be reused and not directed to the sump.

To assess the long-term water balance of the sump, a simple and generic water balance was conducted and used to assess the spill risk of the sump. The Alice Springs BoM gauge was used for long term rainfall and evaporation data for the region. The sump was assumed to have a surface area of 1000m².

The findings of the assessment are provided in Figure 7-1 below, which shows the daily rainfall and evaporation at the base of the graph, and the available storage at the top of the graph. Over the 121

⁴¹ The 1:1000 ARI event is equivalent to a 0.1% AEP event

years of data analysed, average yearly evaporation from the sump was 2.39ML whilst average annual rainfall was 0.31ML. The graph shows that the lowest available storage volume of the sump through the simulated period was 0.85ML. Therefore, the proposed sump, with a capacity of 1.3ML, has sufficient storage to contain a 0.1% 72hr AEP rainfall event (0.5ML) with appropriate freeboard.

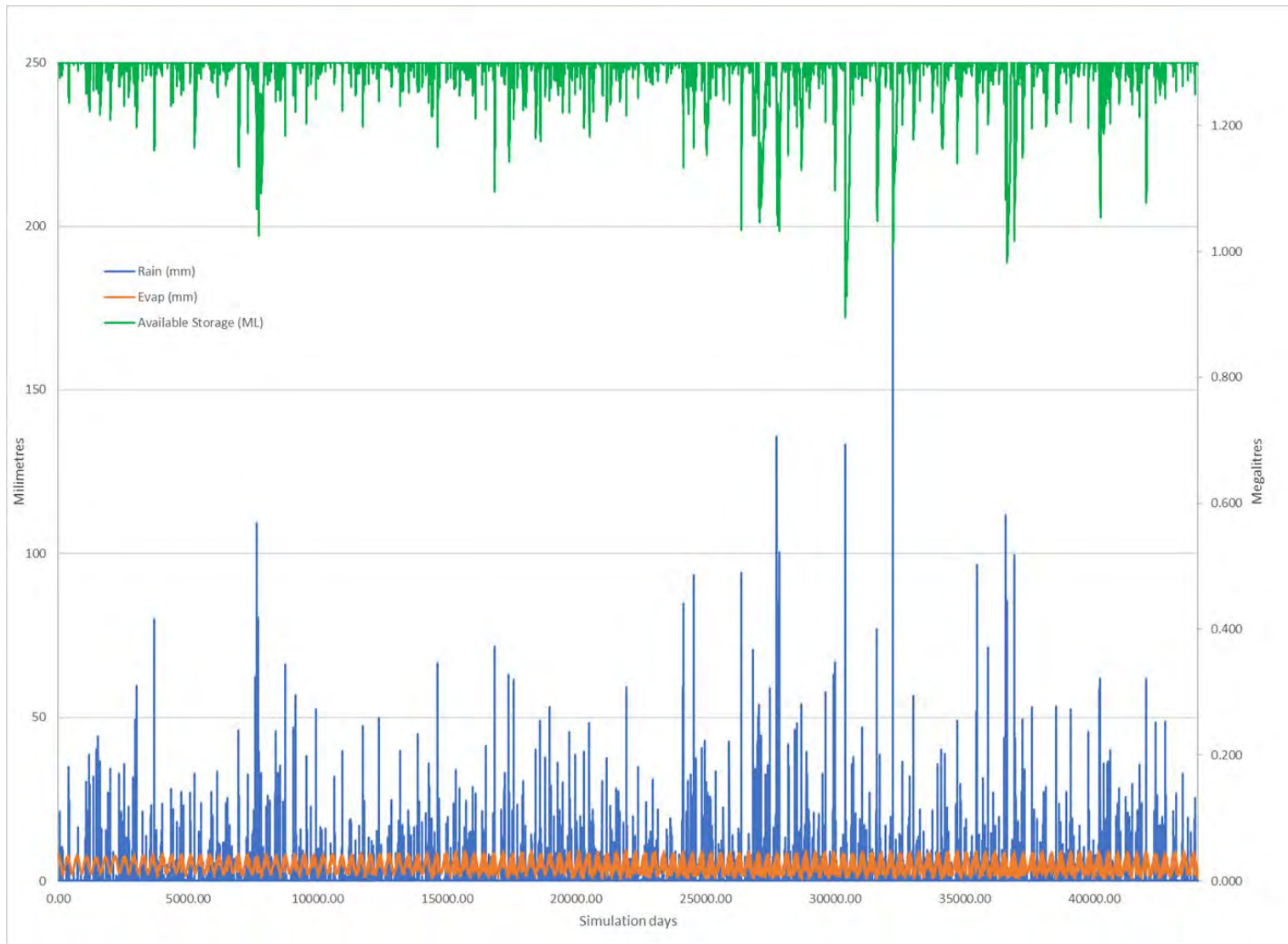


Figure 7-1 Predicted daily rainfall and available wastewater sump storage. Highest predicted rainfall intersects with a sump storage capacity of 1.3ML.

7.4.8 Wastewater Risk Assessment

The risks associated with wastewater are covered in the risk assessment component (Table 6-5) of the EMP. In summary the risks are:

- Contamination of aquifers
- Contamination of surface waters
- Contamination of soil
- Fauna deaths / injury.

Control measures to prevent contamination of aquifers, surface waters and soils from the treatment, handling and re-use of wastewater have been assessed as part of the risk assessment in Section 6.0 and this wastewater management plan. The controls include:

- Tank storages areas to have secondary containment
- Sumps are lined
- Chemical mixing area and drilling fluid mud tanks will be surrounded by a drain that terminates in the lined, mud sumps
- Provide portable spill containment equipment (e.g. spill trays) at each of the facilities
- Undertake inspection of locations for leaks/spills and rectify where detected
- Ensure all fittings and equipment are checked and maintained
- Ensure that any spills, leaks or points of excessive wear are appropriately reported, and the necessary maintenance work and control measures undertaken
- Material in sump to be tested if suitable for burial onsite or if offsite disposal is required
- Test the hydrotest water prior to irrigation to ensure no impacts to soils or surface waters
- Utilise a licenced waste transporter for the transfer of wastewater for re-use, recycling, treatment and/or disposal
- Implement Spill Management Plan.

Control measures to prevent interactions of wildlife, stock and human receptors with wastewater have been identified in the risk assessment (Table 6-4) and includes:

- Temporary fencing around wastewater storages
- Inductions for persons attending each location on wastewater storage locations.

All risks associated with wastewater have been assessed to a level that is ALARP and acceptable.

7.4.9 Monitoring

A wastewater monitoring program will be implemented during the drilling campaign. Table 7-4 provides a summary of the monitoring program.

Table 7-4 Wastewater Monitoring Program

Item	Requirements	Frequency	Parameters
Baseline soils	0.6m deep soil cores from 3 locations across the well site, adjacent to: Well location Storage / mixing tanks sump	Prior to civil works for the well lease occurring	Permeability Particle size Total chlorides Exchangeable sodium Emmerson aggregate test

Item	Requirements	Frequency	Parameters
Stored water	Measure groundwater volume extracted from bores via flowmeter Measure groundwater quality from bores Third party supplied water – volume and quality to be supplied by provider	From Bore Volume – as extracted Quality – minimum one sample prior to use Third party supplied Prior to delivery	From Bore Volume Quality – as per Table 6 of the Code of Practice Third party supplied As required by supplier
Drill fluid	Measure quantity stored onsite Measure quality	Volume - daily during drilling Quality – minimum one sample	Volume Quality – as per Table 9 of the Code of Practice <i>As per Waste Management and Pollution Control (Administration) Regulations 1998</i> (if offsite transport required)
Drill cuttings	Measure quantity (estimate based on actual drill data) Measure quality	Quantity – Prior to disposal Quality - every major source rock interval	Volume Naturally Occurring Radiation Material (NORMs) <i>As per Waste Management and Pollution Control (Administration) Regulations 1998</i> (if offsite transport required)
		Prior to decision on disposal method	Leachability (as per AS4439.2 and 44396.3 and CoP C.4.1.2 (e)) Quality - as per Table 9 of the Code of Practice
Sump capacity / integrity	Analysis of available freeboard within the sump	Daily during drilling Monthly or after significant rainfall event until rehabilitated	Volume
	Visual inspection of integrity of sump		
Wildlife / stock / human interactions	Inspect control measures at sumps / tanks	Daily during drilling Other times - Monthly	Sumps – temporary fencing still intact Tanks – no bridging equipment to the tank

Water samples will be collected by a suitably qualified person and be in accordance with AS/NZ5667.1:1998 *Water Quality Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*. All samples will be collected by appropriately qualified personnel, with all meters suitably maintained, laboratory checked and calibrated in accordance with the manufacturer's instructions.

Samples will be collected in laboratory supplied sampling containers and placed in chilled eskies and transported under chain of custody procedures. Analysis will be performed by laboratories with National Association of Testing Authorities (NATA) accredited analysis methodology.

Where there is no NATA accredited laboratory for a specific analyte or substance, then duplicate samples will be sent to two separate laboratories for independent testing.

Analysis of water samples will be in accordance with the Code of Practice.

7.4.10 Measurement Criteria / Control Measures

The measurement criteria and control measures outlined in Table 7-5 have been developed to demonstrate that risks associated with wastewater storage are reduced to ALARP.

Table 7-5 Wastewater Measurement Criteria and Control Measures

Measurement Criteria	Control Measure
Nil overtopping events from the sump / tanks	- Wastewater to be evaporated - Where minimum freeboard is not available after an inspection, arrangements are to be made for collection of liquid and offsite disposal until the minimum freeboard is achieved
Nil wastewater releases beyond the well lease	- Transfer between rig and sump / flare pit occurs in aboveground pipework. Visual inspections of the pipework during the transfer is performed - Onsite spill kits - Sumps lined as per C4.1.2(e) of the Code of Practice
No releases of contaminants (waste waters) resulting in long-term contamination of soil or surface waters	- Refer to Spill Management Plan - Utilise a licenced waste transporter for the transfer of wastewater for re-use, recycling, treatment and/or disposal
Maximise transfer of recycled fluids between wells where applicable.	- Treat fluid to avoid bacteria and prolong operational lifespan - Separate fluids from cuttings as much as possible to maximise recycling of fluid and reduce fluids in the sump to be remediated
No impact from the re-use of hydrotest water for irrigation on soils or surface water	Test the hydrotest water prior to irrigation to ensure no impacts to soils or surface waters
Access to wastewater storage restricted	Temporary fencing to be installed around sump and flare pit

7.4.11 Wastewater Tracking and Reporting

The movement of wastewater will be tracked and reported in accordance with the following:

- Volumes of water used for each well
- Volumes of water and wastewater reused in petroleum operations
- Volumes of water and wastewater used for other purposes including dust suppression and construction water
- Volumes of water and wastewater removed from site and its destination (whether by vehicle or flowline) including details of the licence number of any licensed waste transporters
- Volumes of any spills of water or wastewater
- Wastewater tracking is to be documented in an auditable chain of custody system
- Wastewater tracking will also be in accordance with other legislative requirements such as those imposed under the *Waste Management Pollution Control Act 1998* and the *Radiation Protection Act 2004*
- Wastewater tracking documentation (records) will be reported to the Minister at least annually as per C.6.1(d) of the Code of Practice.

7.5 Spill Management Plan

The Code of Practice requires a spill management plan that assesses and manages the risks posed by potential spills of waste, wastewater, produced oil or condensate, fluids and any chemicals used or stored as part of petroleum activities. The spill management plan must contain the following:

- Description of chemicals, water and wastewater and the way that they will be stored, transported and transferred as part of the petroleum activity, this includes fluids which are mixed and pumped on site
- Description of the spill scenarios that may occur including an assessment of the duration of the activity and the mechanism, location, quality and quantity of a material that may be spilled
- Risk assessment of the potential impact to the environment of a spill
- Description of the procedures and processes to be used to prevent or minimise the risk of spill from occurring
- Description of methods used to detect a spill, including monitoring methods, frequency of monitoring and the minimum volume spill or leak that would be detected between monitoring events
- Spill management response strategy including a communications plan.

Spill management regarding well operations will be undertaken in accordance with the relevant Field Environmental Management Plan that the well is located within (refer Section 4.7 for relevant plan).

7.5.1 Potential Spill Materials

Section 4.8.5 contains a list of the chemicals that are stored at the well lease (and their designation as a hazardous chemical) and are subject to potential spill. Section 4.8.5 also assesses whether the spill materials are a hazardous substance.

In addition to the chemicals provided in Section 4.8.5, wastewater described in Section 0 also has the potential for spills.

7.5.2 Potential Spill Scenarios

Potential sources of spills associated with the drilling program include:

- Storage of chemicals
- Handling / mixing of chemicals
- Transfers between tanks / drill sump and the drill rig
- Drill rig refuelling
- Transportation (on/off site) of chemicals
- Storage in tanks or drill sump on well leases
- Storage of liquid waste.

Table 7-6 provides a summary description of the potential spill scenarios as well as the estimated duration, spill mechanism, location, quantity and quality of material that may be spilled.

The loss of containment due to the failure of well barriers is covered under the WOMP.

7.5.3 Procedures and Processes

CP has implemented a number of procedures and processes to minimise the risk from leaks and spills from occurring. In general, these are:

- Chemicals are stored in bunded areas
- When outside bunded areas, chemical containers / tanks have spill absorbent materials underneath them to minimise contact with the soil

- Minimising the quantity of chemicals stored onsite to those that may be required for the drilling campaign (including the contingency chemicals required for the drilling fluid)
- Diverting flood water away from the lease
- Undertaking a monitoring program to detect leaks or spills in an expedient manner. The monitoring program frequency is designed to detect a spill or leak before sufficient quantity has been released that would cause environmental impacts to a ground or surface water.
- Spill kits are available at each well lease.

In addition to those listed above Table 7-6 provides a summary of additional the spill detection methods and control measures that CP will undertake during the drilling program.

Table 7-6 Spill Scenario and Controls Summary

Activity	Activity Duration	Spill Mechanism	Location	Potential Spill Quantity	Quality	Detection Method	Controls
Storage of chemicals	20 – 86 days per well	Container rupture Lids / taps not fitted / fitted correctly	Chemical storage area Portable trailer Workshop	25 L ⁴²	As per SDS for the respective chemicals	Visual	Daily inspection of the chemical storage area and portable trailer Chemical storage area, workshop and trailer bundled Diesel tank (double wall)
Handling / mixing of chemicals	20 – 86 days per well	Poor handling / mixing practices Poor transfer into tanks Overtopping of tank	Chemical storage area (bundled) Chemical loading area Tanks	100 L		Visual Tanks - Alarmed	Handling / mixing performed by a competent person Visual assessment during mixing / transfers Daily inspection of the chemical storage and loading area Chemical storage area bundled Spill absorbent material beneath the chemical loading area / tanks Tanks - alarmed
Transfers between tanks / drill sump and the drill rig	20 – 86 days per well	Coupling, hosing and pipe failures	Tanks Pipework	100 L		Visual	Real time monitoring of tank volumes Daily inspections during drilling

⁴² Based on the largest container of liquid in the chemical storage area releasing contents before next daily inspection

Activity	Activity Duration	Spill Mechanism	Location	Potential Spill Quantity	Quality	Detection Method	Controls
Drill rig refuelling	Every 10 days during drilling	Incorrect refuelling setup Poor refuelling practices	Rig fuel tank Diesel truck	100 L		Visual	Operators maintain visual contact whilst refuelling the rig fuel tank
Chemical transportation (on / off site)	1-2 day mobilisation and 1-2 day demobilisation	Incorrect storage Incorrect loading / unloading technique Traffic incident	Vehicle	20-100 L Traffic Incident – up to 20,000kg ⁴³		Visual	Visual assessment during loading, unloading Emergency response in event of traffic incident
Storage of wastewater in sump	12 months	Overtopping of sump	Well lease	1,000 L		Visual Daily during drilling Post drilling Weekly in dry season Daily in the wet season	Sump designed with freeboard of 0.1% AEP rainfall event
Storage of liquid waste (oils degreasers etc)	20 – 86 days per well	Container rupture Lids not fitted / fitted correctly	Camp and well lease waste storage areas			Visual	Daily inspection of waste storage area

⁴³ Based on single transport vehicle traffic incident

7.5.4 Spill Risk Assessment

The risks associated with spill scenarios in Section 7.5.2 are covered in the risk assessment component (Table 6-5) of the EMP. In summary the spill scenarios present the following risks and potential impacts:

- Contamination of groundwater – chemicals used or transported (within CPs control) during the drilling program have the potential to leak or be spilled at surface and infiltrate to the ground, migrating to shallow or perched aquifers. This may affect groundwater quality
- Contamination of surface waters – chemicals used or transported (within CPs control) during the drilling program have the potential to leak or be spilled at surface and migrate to surface waters and affect surface water quality and ecological values of the habitat
- Contamination of soil - chemicals used or transported (within CPs control) during the drilling program have the potential to leak or be spilled at surface. Smaller spills and leaks are likely to be retained in the soil and not migrate to groundwater or surface waters.

7.5.5 Spill Monitoring

The monitoring program to detect spills is summarised in Table 7-7.

Table 7-7 Spill Monitoring

Activity	Monitoring Method	Monitoring Frequency	Potential volume of leak between monitoring events
Chemical storage area	Visual	Weekly during drilling Daily during the wet season	25 L
Portable storage	Visual	Weekly during drilling Daily during the wet season	20 L
Drill fluid tanks	Instruments	Continuous during drilling	100 L
Chemical loading area	Visual	Weekly during drilling	100 L
Sump / flare pit	Visual	Weekly during drilling Daily during the wet season Monthly until rehabilitated	1,000 L
Diesel storage	Visual	Weekly during drilling Daily during the wet season	100 L
Rig refuelling	Visual	During rig refuelling	100 L
Waste storage area	Visual	Weekly during drilling Daily during the wet season	20 L

As part of the spill monitoring program outlined in Table 7-7 above, and in accordance with the frequencies listed, the following items are to be integrity checked:

- Containers (Packages, tanks etc)
- Fittings and equipment
- Bunds

Where any spills / leaks are observed or potential integrity issues is identified, these are to be reported immediately to the supervisor onsite, and the necessary maintenance work and control measures carried out as soon as practical.

7.5.6 Spill Response Management

The following sections provide an overview of the response to spills that may occur during activities under this EMP. Where the spill is assessed as triggering the Emergency Response Plan the requirements of the Emergency Response Plan will prevail over the requirements contained in this Spill Management Plan

7.5.6.1 Spill Categories

CP uses a three-tiered spill category to determine whether a spill may trigger the Emergency Response Plan. Table 7-8 outlines the three spill categories.

Table 7-8 Spill Categories

Category	Factors Assessed/Actions
Level 1	- Spills that can be contained within the disturbance footprint and can be cleaned up by on-site personnel without involvement of external organisations. Most Level 1 spills are likely to be less than 200 L and would include diesel spills during fuel transfer, oil spillage during routine maintenance, chemical spills during mixing storage or small wastewater spills. - Clean up to commence immediately with the equipment available on site - Clean up time is generally less than 1 day. - Emergency Response Plan not triggered.
Level 2	- Spills that have not been completely contained within the site boundary and/or may require additional resources to clean-up and the spill has not entered a sensitive environmental or cultural feature (e.g. waterways, significant fauna habitat, sacred site etc). - Contain the spill immediately with the equipment on site - Clean-up to commence once spill equipment is mobilised to site (1 day to mobilise) - Clean-up time is generally within a week - Emergency Response Plan not likely to be triggered.
Level 3	- Spills that cannot be contained by the operator and requires substantial additional resources to manage the spill or the spill has entered a sensitive environmental or cultural feature (e.g. waterways, significant fauna habitat, sacred site etc). - Contain the spill immediately with the equipment on site - Clean up to commence once spill equipment is mobilised to site (1 day to mobilise) - Clean up time is generally greater than a week. - Emergency Response Plan to be triggered.

7.5.6.2 Rapid Spill Assessment

Where a spill has been discovered the Onsite Company Representative is to be reported immediately to the supervisor onsite and they will conduct a rapid spill assessment to determine whether the Emergency Response Plan is to be triggered or whether containment and clean up in accordance with Section 7.5.6.3 is to occur as soon as possible. The rapid spill assessment is to consider the following:

- Volume and location of the spill
- Spill containment and clean up required
- Spill category
- Safety hazards to personnel from the spill and during containment and clean up.

7.5.6.3 Spill Containment and Clean Up Process

The following process is to be utilised during containment and clean-up of a spill:

- Ensure personnel are removed from any harm / potential harm

- Alert others to the spill
- If safe to do so:
 - Remove any potential escalation factors (e.g. ignition sources etc)
 - Isolate the spill source
- Contain the spill using onsite containment resources (e.g. spill kit materials, stockpiles etc). Safety data sheets for the spilled materials are to be reviewed to determine the appropriate containment approach
- Clean-up the spill using onsite clean-up equipment (e.g. spill kit materials etc) by:
- Recovering free liquid
- Removing contaminated material and storing in the waste storage area
- Where clean-up will take longer than one day, consider the use of temporary fencing to prevent access by personnel, livestock, and terrestrial fauna
- Store used clean-up materials in the waste storage area
- Arrange for wastes to be disposed offsite in accordance with the Waste Management and Pollution Control Act 1998.

7.5.7 Communications

Spills will be communicated to the following people / organisations:

- DEPWS / DIPR - as per Section 10.0
- Landholders – within 24 hours of the Emergency Response Plan being triggered.

CP ensures each active well site is clearly identified with the well name, well number, major hazards and details of the interest holder displayed at each well site (including the name of the person in charge). Where landholders observe spills / leaks occurring from unmanned sites they will be able to report these to CP based on the displayed information.

Any spills that occur outside of the permit area will be reported to the NT Pollution Hotline (1800 064 567) and in accordance with the *Waste Management and Pollution Control Act*. If a spill occurs inside the permit area and then travels outside of the permit area it will be reported to the NT Pollution Hotline in addition to the reporting requirements in Section 10.0.

7.6 Methane Emissions Management Plan

Clause D.2 of the Code of Practice limits mandatory requirement for a Methane Emissions Management Plan to onshore shale gas fields. Activities under this EMP relate to conventional oil and natural gas exploration / production. Despite this, CP will be undertaking a range of activities that manage methane emissions from the drilling campaign.

Table 7-9 provides a summary of activities under this EMP which have the potential for methane emissions and the associated emission description and monitoring.

Table 7-9 Emission Descriptions and Monitoring

Activity	Emission Description	Emission Monitoring
Drilling	Methane may be entrained in the cuttings from the target formation that are brought to the surface	Gas detectors are situated on the rig site and all returns are monitored for background hydrocarbon. In conjunction with routine collection of gasses from the drilling process ensures that data is collected from target formation allowing emission estimates
Well testing	Hydrocarbons are brought to the surface and flared. Minor quantities of methane may be released prior to flaring as the hydrocarbon production rate may not sustain a flare initially	Flared gas flow rates are continuously measured
Well suspension (above ground facilities – Petroleum well pad equipment)	Emissions restricted to unplanned leaks from well heads, including surface casing vents	Central Petroleum has a Well Integrity Management System (WIMS). As part of this system routine well including leak detection and methane checks are mandated. The frequency of inspection is inline with the CoP at six months or more frequent.

Note: Activities for production activities (i.e. Compressor Stations) under Code of Practice 5.2.2 (d) and Table 10 have not been listed in Table 7-9 as production activities will not be approved under this EMP

Measurement of emissions during this monitoring will be consistent with the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

7.6.1 Equipment Selection and Activity Design

The uncontrolled emissions of natural gas during drilling and well testing activities represents a potential hazard to workers and the environment. All equipment will be selected to minimise the emissions during these activities. Wells and associated surface infrastructure shall be designed to mitigate leaks in accordance with the relevant standards. These Standards include:

- ISO 16530-1-2017 Petroleum and natural gas industries - Well Integrity - Life cycle governance
- API SPEC 5CT 2016 Casing and Tubing
- API SPEC 16D 2013 Control Systems for Drilling Well Control Equipment and Control Systems for Diverter Equipment
- API RP 59 2012 Well control operations
- API SPEC 6A 2016 Wellhead and Christmas Tree equipment
- NORSOK Standard D-010, Well integrity in drilling and well operations
- Leak detection implemented consistent with the Code of Practice.
- Ongoing well maintenance as per the Well Operations Management Plan.

7.6.2 Leak Detection Inspections

A leak detection inspection program will be implemented in accordance with Table 7-10 .

Table 7-10 Leak Detection Surveys

Where	Frequency
Drilling of well	Continuous whilst drilling.
Suspended wells	Six-monthly after well is suspended

7.6.3 Leak Detection Instruments

Portable gas detectors are to be carried by personnel during attendance at each well location and are to be capable of detecting:

- Flammable gases and vapours, as well as O₂, CO, NO₂, SO₂ and H₂S; and
- Methane as low as 500ppm (1% of the lower explosive limit (LEL)).

Gas detectors will be calibrated and bump tested in line with manufacturer's recommendations and be consistent with United States EPA Method 21. Additionally, gas detection instrument, operation and calibration will be consistent with the United States New Source Performance Standard 2016.

All personnel using gas detectors will be trained and competency assured in the use.

Measurement of emissions from leaks will be consistent with the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

7.6.4 Leak Detection Procedure

Leak detection is undertaken in accordance with the US EPA Method 21. The following is a summary of the process CP undertakes for leak detection:

- Prior to commencing monitoring the gas detector is calibrated.
- A suitably qualified person then undertakes the following monitoring at each of the wells sites and along the gathering system (vents, drains, metering instruments, manifolds):
 - Place the probe at the surface of the component interface where leakage could occur
 - Move the probe along the interface periphery while observing the instrument readout
 - Locate the maximum reading by moving the probe around the interface (note that where a leak is detected the operator is to make a determination as to whether it is safe to remain in the area to continue monitoring
 - Keep the probe at the location of the maximum reading for 2 times the response factor
 - Record the reading and source of the leak (if a leak is detected)
- If a leak is detected also record whether it is a minor or significant leak (as per Code of Practice D.5.5) and implement corrective actions
- If a liquid petroleum leak is detected and it is safe to do so, record the estimated volume of leaked liquid and the source of the leak (note that if cannot record the volume, it is to be assumed that the volume exceeds the reportable threshold).

7.6.5 Leak Remediation and Notification

When a leak is detected the source will be isolated immediately and rectified. Remediation of the leak (including timeframes) will be undertaken in accordance with section D.5.6 of the Code of Practice.

Where leaks have been detected a risk assessment is required to be undertaken to determine whether an increased inspection frequency is required.

The leak will also be recorded in CP's internal reporting system and reported to the Regulator as required in the EMP.

7.6.6 Venting and Flaring

No venting is proposed under this EMP. Any gas brought to surface as part of the testing of the well will be flared.

In the unlikely event that venting does occur, DITT and DEPWS will be notified.

Reporting

In line with the Code of Practice requirements, reporting of the leak detection surveys outlining the following will be included in the annual report prepared under Section 10.1.4:

- Extent of compliance with this plan
- Summary of monitoring undertaken during the period
- Summary of minor and significant leaks identified during the reporting period, including the date of identification and repair for each leak and those leaks which could not be repaired
- Explanation of why any component could not be repaired and what actions will be taken to either decommission the component or remedy the situation.

7.7 Wet Season Operations Management Plan

7.7.1 Scope

Wet season operations will be undertaken under this EMP. The scope of this plan is to ensure that all activities described in Section 4.0 can be carried out in the wet season.

7.7.2 Objectives

- Ensure that all activities can be undertaken safely and with minimal risk to the environment during the wet season
- Have the ability to transport critical items if necessary, during the wet season

7.7.3 Climate

In general, all the proposed drilling locations experience an arid to semi-arid climate, which is characterised by hot dry summers and cool dry winters with a low average annual rainfall. Typically, more rainfall occurs in the summer months associated with monsoonal influences; however, the amount of rainfall in the arid zone has a history of being highly variable. Table 7-11 provides representative temperature and rainfall data from the Alice Springs airport. Refer to section 5.0 for specific climate data for each field.

Table 7-11 Alice Springs Airport monthly climate statistic

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean max temp (°C)	36.5	35.2	32.8	28.4	23.1	19.9	19.9	22.7	27.4	31.2	33.8	35.5
Mean min temp (°C)	21.6	20.8	17.6	12.7	8.2	4.9	4.0	5.9	10.3	14.8	17.9	20.3
Mean Rainfall	40.6	41.2	31.0	16.4	18.2	12.8	14.7	8.6	8.7	20.0	28.2	38.1
Mean number of days of rain (mm)	3.4	3.4	2.3	1.5	2.1	1.6	1.6	1.2	1.4	2.7	3.7	4.2

(BOM.gov.au accessed August 2020)

7.7.4 Wet Season Monitoring

During activities in the wet season CP will undertake the monitoring in Table 7-12, which will provide the necessary information to communicate to staff and sub-contractors when to be wet weather prepared and inform the necessary actions to be undertaken.

Table 7-12 Wet season monitoring

Monitoring	Information location/Action	Frequency
Weather forecast (long-term and short-term)	http://www.bom.gov.au/nt/	Daily
Road conditions	https://roadreport.nt.gov.au/home	After a rain event
Containment Areas and sumps	Visual inspections and reporting	Daily

7.7.5 Wet Season Management

Where wet season operations are undertaken the following risk controls will be implemented:

- Sufficient chemicals, fuels, equipment, tanks and materials required for ongoing operations will be stored onsite prior to the onset of the wet season. This includes 10 days allowance of required fuel
- Operations are shut down during significant wet weather or flooding and only restarted once potential for extensive damage has passed
- Following shut down due to flooding or inundation the risk assessment will be revisited to ensure controls are still appropriate to manage risk to ALARP
- All drilling and civil equipment required to respond to emergency situations will be onsite; this include earth moving equipment and cementing equipment etc
- All chemicals storage areas will be bunded, with covers used to prevent rain ingress and bund overflows where possible
- Wastewater tanks and mud sumps will have enough freeboard to manage an entire 1:1000 ARI wet season event
- Helicopters will be used to transport people and supplies in and out of site when access is restricted
- Where transportation of chemicals is necessary during the wet season, the logistics of the delivery of chemicals will be undertaken in consideration of the monitoring information. Chemicals will not be delivered during rain events
- After a rain event any unsealed roads will be inspected to ensure they are safe for the transportation of chemicals and materials
- Earthworks during the wet season will be minimised as much as possible
- Erosion & Sediment Controls will be examined after each rain event and repairs undertaken if required
- Overland flow will be diverted around lease pads

7.8 Rehabilitation Management Plan

7.8.1 Scope

The rehabilitation management plan applies to land disturbance as a result of the activities listed under Section 4.0, specifically wells and access roads that are decommissioned after being drilled and tested. It does not, however, include the rehabilitation of wells that are completed for production purposes.

For wells that are completed and become production wells, rehabilitation will be undertaken in accordance with the applicable FEMP for the well location (refer Section 4.7). For wells that are completed and suspended or decommissioned and do not fall under an existing FEMP they will be managed under this EMP.

Rehabilitation will be undertaken in accordance with Code of Practice: Onshore Petroleum Activities in the Northern Territory (31 May 2019) and in consideration of the Rehabilitation Plan Guide for Surface Disturbance: onshore petroleum exploration (17 September 2020, version 4.0).

The Rehabilitation Plan Guide provides guidance on the 'minimum information required for a Rehabilitation Plan'. In Table 7-13 CP recognises the minimum information and provides how it is addressed in this plan.

Table 7-13 Rehabilitation Plan Guide for Surface Disturbance: minimum information

Minimum information	How addressed
Identify rehabilitation management zones	The activities in this EMP cover two management zones; zone 1 - well pads, zone 2 - flowline right of ways, and access tracks
Identify future land use(s)	Refer Section 5.0, land tenure description and 7.8.5
Develop objectives and endpoints for each zone	Refer to Table 7-15
Develop actions for each zone, including corrective or remediation actions	Refer to Table 7-15
Undertake risk assessments, identify mitigations, and determine residual risks to rehabilitation success	Refer section 6.0. Risk assessments will be updated if material changes occur during activities and operation.
Develop and implement a monitoring program	Refer to Table 7-15

7.8.2 Objectives

The objectives of this rehabilitation management plan are to:

- Minimise disturbance as far as reasonable practicable
- Progressively rehabilitate significantly disturbed land which is not required for ongoing activities
- Return all disturbed areas to a safe and stable landform as close as possible to the surrounding environment
- Ensure significantly disturbed land is re-established to its pre-disturbed condition and land use
- No residual contamination
- No land management issues for future land managers.

7.8.3 Progressive Rehabilitation

Prior to and during operations, activities are undertaken to improve the success of rehabilitation these include:

- Selection of preferred location base on multi-criteria assessment as per this EMP
- Completion of pre-disturbance surveys (Appendix 2 – Baseline Ecology Survey)

- Preparation of maps defining boundaries of different rehabilitation management areas or zones and infrastructure, including access roads
- Risk assessments (new or updated) based on collected information
- Topsoil is stockpiled onsite around the edges of the lease in low profile mounds (<2m) to preserve the biological activity
- Vegetation stockpiled separately on the edge of the lease preserved for seed bank, habitat and erosion protection
- Erosion and sediment devices are put in place as per the ESCP
- All wastes managed as per Section 4.8.5 Chemical Storage and Use
- Weed management plan implemented.

Once the drilling activities are completed and the well is successful, the well will either be put into production or cased and suspended for future production. In both cases the following activities will be undertaken:

- The mud sumps, flare pit and water storages are filled in. This process includes:
 - Once drilling fluids have evaporated from the mud sump the cuttings will be tested to determine if suitable for burial on site or if disposal off site is required. (Determine salinity and heavy metals are below NEPM 2013 trigger guidelines concentrations to be buried on site)
 - following the mud sumps, flare pits and water storages being filled in the temporary fence is no longer required and it will be removed
- The lease is prepared for operations so that the wellsite production equipment and safety systems can be installed, commissioned and operated safely
- Where practical the leases are reduced in size and rehabilitation of these surplus areas are rehabilitated to achieve the rehabilitation outcomes described in Table 7-15 in the future when the site is decommissioned.

Once the decision is made to decommission the well because it is an exploration well or is uneconomical the following activities are undertaken:

- The well is decommissioned as described in Section 4.6
- The wellhead is removed, the casing cut per the Code of Practice: Surface cement plug detailed in B.4.15.3: Cement plug requirements and validation methods. A steel marker plate installed to identify the well and details per the Code of Practice
- Any imported gravel material is removed and returned to the source quarry or utilised elsewhere on CP operational sites
- The site is re-contoured as close as possible to the pre-existing natural landscape
- Hardstand is deep ripped to relieve compaction, encourage infiltration and water retention
- Topsoil is respread evenly over the lease area and lightly scarified to encourage moisture retention and seed capture
- Vegetation is respread over the lease, this acts as erosion control, provides habitat and promotes natural revegetation
- Any weeds or invasive species are managed per the weed management plan during the rehabilitation process
- Temporary erosion and sediment controls to support the rehabilitation designed and installed where required
- All waste removed from site
- If natural revegetation success is low, seeding may be required, this will be assessed through the monitoring program.

7.8.4 Environmental Actions and Monitoring

Table 7-14 details the actions required to meet the environmental requirements for rehabilitation and monitoring in order to determine that these objectives have been achieved. These strategies are applicable to all rehabilitation management zones.

Table 7-14 Environmental Strategies and Monitoring

Activity	Strategies	Timing
Analogue sites⁴⁴	Identify appropriate analogue sites for each of the disturbance areas	After the first wet season in conjunction with the first monitoring event
Post Decommissioning	Remove above ground infrastructure Remove rubbish Backfill sumps / pits to ground level Re-spread vegetation previously cleared	Commence within 12 months of well being decommissioned
Land use	The final land use options will be determined in consultation with the landowners and other relevant stakeholders and may include: - Pre-disturbance land use - Tourism related activities - Conservation (reserve or park) - Grazing or horticultural activities.	Commence within 12 months of well being decommissioned
Soil Stability	Remove any flow concentration points that may block overland sheet flow Re-instate natural drainage channels (i.e. removal of bunds and structures that temporarily altered flow paths) Return soil profile with topsoil replaced as final layer where possible Deep ripping and contouring of access roads, well leases and camps to as close to natural landform as possible Ensure all cleared areas have a rough surface to aid in water, seed and litter catchment Erosion and sedimentation devices installed and maintained as per the ESC Plan	Commence within 12 months of well being decommissioned
Contaminated soil	Undertake remediation of contaminated soil in accordance with spill management plan / emergency response plan	Remediation of contamination to be undertaken immediately.
Revegetation	Revegetation of well lease size after completion of testing to the following: - Case and suspended well – 50 m x 50 m - Decommissioned well – 2 m x 2 m - Revegetation of accommodation camps - Revegetation of access tracks	Lease - commence within 12 months of case / suspend or decommissioned Camps / access tracks – commence within 12 months of infrastructure no longer being required

⁴⁴ Analogue site means an area of land which contains values and characteristics representative of an area to be rehabilitated prior to disturbance. Such values must encompass land use, topographic, soil, vegetation, vegetation community attributes and other ecological characteristics. Analogue sites can be the pre-disturbed site of interest where significant surveying effort has been undertaken to establish benchmark parameters. Analogue sites will be chosen by a suitably qualified person.

Activity	Strategies	Timing
Monitoring	All monitoring to be undertaken by a suitably qualified person and in accordance with this Plan	Refer to Table 7-15 for monitoring activity and timing

7.8.5 Rehabilitation Success

Rehabilitation site success is identified through information obtained in the pre-disturbance land condition assessment and adjacent vegetation communities (analogue site). Some of the risks to rehabilitation success and proposed actions to address include:

- Climate - these sites are located in semi-arid locations and if rainfall does not occur it will impede revegetation. Seeding will be completed prior to the wet season to get the best possible germination and vegetation establishment
- Erosion & sediment impacts occur before the vegetation has a chance to germinate. An ESCP will be developed specific to the rehabilitation program to minimise this risk
- Lack of topsoil and soil inversion can impact the success of rehabilitation. The soils are to be returned to pre-disturbance soil profiles and topsoil spread over the entire lease evenly. Topsoil may need to be brought in if there is a lack of topsoil
- Weed infestations will hinder rehabilitation. CP will implement the weed management plan to minimise the risk of weed impacts
- Grazing of the lease by the Landowner will impact the success of the rehabilitation. The rehabilitation area will be fenced to limit impacts from grazing.

As per the Code of Practice A.3.9 (a) CP has developed clear outcomes and performance standards. These outcomes and performance standards will be achieved through the supporting measurement criteria developed to be achievable and measurable.

Table 7-15 details the acceptability criteria, which includes the performance standards and measurement criteria that CP will utilise to assess the success of rehabilitation. The table also includes the monitoring program designed to track the success of rehabilitation. In addition, the table discusses potential corrective actions that may be required depending on the outcome of the rehabilitation monitoring and recommendations from a suitably qualified person.

Table 7-15 has been designed to incorporate an adaptive management approach to monitoring based on the arid nature of Central NT. CP understands that the Code of Practice states in A3.9 (e) regular maintenance and at least yearly monitoring of rehabilitated areas must take place to measure compliance with the Rehabilitation Plan. CP is committed to yearly monitoring and the monitoring will be in service of achieving the acceptability criteria as quickly as possible. The type of monitoring (qualitative/quantitative) will be highly dependant on the seasonal conditions (i.e. how much rain was received over a wet season) and will be decided year on year based on the recommendations of a suitably qualified person.

Table 7-15 Rehabilitation measurement criteria and monitoring program

Rehabilitation Outcome	Acceptability Criteria			Annual Monitoring Program			Corrective Actions
	Endpoint(s)/Performance Standards	Measurement Criteria	Rational	Frequency	Proposed Methodology (adaptive depending on seasonal conditions)	Rational	
- The vegetation composition (e.g. type, density and maturity) of the rehabilitation is recognisable as the target vegetation community and indistinguishable from the surroundings. - The vegetation structure of the rehabilitation is recognisable as, or is trending towards the target plant community. - Access tracks and/seismic lines are indistinguishable from the surrounding vegetation. - No adverse erosion	- Dominant species in analogue sites are represented in rehabilitated areas - Community structure is substantially the same as the analogue site/s groundcover, shrubs and trees - Perennials have established, stabilising soils and reducing erosion potential - Habitat structures and habitat quality are substantially similar to analogue sites, creating connection to the adjacent landform and vegetation allowing for fauna re-use of the site - Completely stable (or in dynamic systems such as dunal landforms, same degree of stability as surrounding terrain)	- Ground cover - 70% foliage cover and density of the analogue site - Perennial Cover-recruitment of woody perennial species achieves 70% of the analogue site - Plant species richness achieves 70% of the analogue site - No declared weed species under the Northern Territory Weeds Management Act - No weed species 50% of the organic litter and coarse woody debris of the analogue site - No evidence of soil subsidence and <2% erosion across the site (qualitative – photo evidence of scarring, rill/sheet erosion)	- Cover equivalent to 70% of the analogue site/s is likely to self-sustain over time and rehabilitated areas become ecologically integrated with surrounding areas - Species richness shows the rehabilitation site is able to support the full complement of species from analogue sites, even if not all species are yet at the same abundance, noting that in an arid environment, species such as spinifex grow extremely slowly - In arid regions soil stability is critical for the success of rehabilitation	Annually, commencing after the first wet season, and noting the following: - The Amadeus Basin is located in an arid region and establishment of vegetation generally is slower than areas with higher rainfall. Therefore, it is unlikely that quantitative assessments will provide meaningful data to determine rehabilitation success in years 1, 2 and 3 - In year 1 the analogue sites will be set up, the photo monitoring points will be established and the permanent woody species transect will be established. The site will be assessed for stability and any weed issues. 2 and 3, if there is no evidence of vegetation regeneration but the sites appear to be stable, and free from erosive forces or fire effects, a visual assessment only of cover and structure will be made. - In year 4, and year 5 monitoring against endpoints will be undertaken. An adaptive approach will be taken year on year for the monitoring. A suitably qualified person may adapt the monitoring based on the seasonal conditions (i.e the wet season). This will be documented in the annual rehabilitation report. - Post 5 years the EMP will need to be updated and	Year 1 2 or more analogue sites in nearby undisturbed vegetation community and landforms as per the analogue definition and selected by a suitably qualified person - Establish permanent woody species transects - Establish photo monitoring and collect photos - Record any weather events during the period - Check for subsidence across the rehabilitated area - Assess the % of erosion across the rehabilitated area. - Check for any loss of topsoil through erosion and map areas of concern - Check for soil inversion issues and map areas of concern - Weed Survey	As per the Code of Practice A3.9 (b) the rehabilitation plan should be appropriate to the scale and nature of the activity. In CPs experience operating in the Amadeus Basin, which is an arid region, the establishment of vegetation takes time. In CPs experience it takes 10+ years for sites to reach the rehabilitation outcomes. The rehabilitation plan has been developed to meet the scale and nature of the rehabilitation (i.e. size of the disturbance and the time to rehabilitation) As per the Code of Practice A3.9 (e) Regular maintenance and at least yearly monitoring of rehabilitated areas must take place to measure compliance with the Rehabilitation Plan. Rehabilitation success relies on good site preparation and rainfall and an adaptive approach for monitoring is required to take in the seasonal conditions. This will rely on a suitably qualified person to assess the seasonal variations and match the appropriate monitoring to undertake each year. This could include the use of technical advances like drones, satellites, remote sensing and lidar to assess the site stability and vegetation cover. The quantitative data is of significant value as the rehabilitation matures and reaches the acceptability criteria and this when the vegetative survey effort should be concentrated. In addition, the year on year growth in an arid environment is slow and therefore yearly monitoring of all parameters is not necessary.	- Weeds impacting revegetation success – implement the weed management plan - Pest species impacting the rehabilitation success – Identify the pest species and put in place measures to protect the rehabilitated areas (e.g. fencing) - Poor vegetation germination/re-growth is limited in richness/ or community structure inconsistent with the analogue site – Infill seeding and/or top dress with a soil additive/topsoil or fertilise - Erosion and sediment control remediation of failed erosion and sediment controls - Review the re-profiling of the site to address any stabilisation issues. Undertake earthworks for re-profiling as necessary
					Year 2 and Year 3 - Check for integrity of works and ability for future rehabilitation success - Record any weather events during the period - photo monitoring - Check for subsidence across the rehabilitated area - Assess the % of erosion across the rehabilitated area. - Check for any loss of topsoil through erosion and map areas of concern - Check for soil inversion issues and map areas of concern - Weed survey		
					Year 4 - Woody species transects from the permanent transect - Collect ground cover quadrants along a transect. - Photo monitoring collected - Record any weather events during the period - Check for subsidence across the rehabilitated area - Assess the % of erosion across the rehabilitated area - Check for any loss of topsoil through erosion and map areas of concern - Check for soil inversion issues and map areas of concern - Weed survey		
					Year 5 - Woody species transects from the permanent transect - Collect ground cover quadrants along a transect. - Photo monitoring collected - Record any weather events during the period		

	Acceptability Criteria			Annual Monitoring Program			Corrective Actions
Rehabilitation Outcome	Endpoint(s)/Performance Standards	Measurement Criteria	Rational	Frequency	Proposed Methodology (adaptive depending on seasonal conditions)	Rational	
				the data collected will be used to update the new rehabilitation plan.	▪ Check for subsidence across the rehabilitated area ▪ Assess the % of erosion across the rehabilitated area ▪ Check for any loss of topsoil through erosion and map areas of concern ▪ Check for soil inversion issues and map areas of concern ▪ Weed survey	The key is to assess if the site is on the right trajectory to achieve the acceptability criteria, this aligns with the adaptive management approach	

7.8.6 Rehabilitation Reporting

CP will submit to the DEPWS an annual rehabilitation report with information including:

- Area of disturbed land available for rehabilitation at the start of the reporting period
- Area of disturbance that occurred during the reporting period
- Area where rehabilitation commenced during the reporting period
- Area of disturbed land remaining to be rehabilitated at the end of the reporting period (including land not currently available for rehabilitation⁴⁵)
- Photographic monitoring point GPS locations and results of monitoring undertaken during the reporting period
- Geospatial files showing areas under rehabilitation in comparison to areas disturbed
- Progressive rehabilitation progress and outcomes as per activities outlined in 7.8.3
- Outcome of erosion and sedimentation assessments and corrective actions
- Outcome of stakeholder consultations related to rehabilitation
- Any issues that may have affected the rehabilitation success factors noted in Section 7.8.5 and remedial actions taken or required to be undertaken to allow the success factor to be realised
- Outcome of monitoring of remediated contaminated sites (if any)
- Outcome of weed monitoring in rehabilitated areas.

⁴⁵ land not currently available for rehabilitation means land that is still required for the activities to be undertaken under this EMP

8.0 Environmental Management

The approach taken in this EMP is based on ESD principles. It aims to provide measurable procedures and practises, to reduce the identified environmental risks to ALARP. This will ensure that the activities under this EMP will have as minimal negative environmental impact as possible, and at completion, the environment will be returned to a suitable landscape conducive to future rehabilitation success.

There will be continual stakeholder engagement and consultation throughout the implementation of the EMP to prevent and mitigate the identified risks and any new risks. Feedback from affected stakeholders will be used to update and enhance the risk assessment and management process.

8.1 Ecologically Sustainable Development

ESD is a concept based on implementing practices and principles that meet the needs of ecological process and people today without impeding on future generations to meet theirs. There is no universally accepted definition of ESD, however the Commonwealth Government of Australia suggested the following:

- Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased' (Ecological Development Steering Committee, 1992).

Forward planning and adaptation of ESD concepts from inception of development will ensure that the environmental impacts of activities under this EMP are minimised throughout the life of CP's occupation and for future land managers.

8.2 Environmental Outcomes and Performance Standards

Based on the result of the risk assessment, CP has categorised the environmental outcomes, performance standards and measurement criteria necessary to facilitate the principles of ESD into the following broad categories:

- Biodiversity Management
- Land Management
- Groundwater Management
- Surface Water Management
- Air Quality Management
- Fire Management
- Heritage Management
- Community Management

The environmental outcomes, performance standards and measurement criteria for these categories are described in Table 8-1 to Table 8-7.

8.2.1 Biodiversity Management

Table 8-1 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for biodiversity management.

Table 8-1 Biodiversity Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant impact to threatened fauna, their habitat and sites of conservation significance during the drilling program	No unauthorised clearing of vegetation	- Area of known threatened fauna will be sign posted to avoid impacts to threatened fauna or their habitat - Permit to work specifies area authorised to be cleared and post clearing surveys confirm no additional or different areas were cleared. - The incident management system shows no incidents of unauthorised clearing
	No uncontrolled bushfires caused by drilling activities	The incident management system shows no incidents of uncontrolled fires.
	Injury to fauna during the conduct of the activity will be minimised	- The incident management system indicates no recorded incidents involving vehicles traveling above site speed limits - The incident management system indicates no recorded incidents of fauna trapped in open excavations - Personnel inductions include specific requirements around protection of fauna, flora and their habitat and compulsory reporting of fauna interactions
	No introduction of new or spread of existing Weeds of National Environmental Significance, weeds listed under NT legislation or locally significant weed species.	- Annual weed survey undertaken - The incident management system shows no new Weeds of National Environmental Significance, weeds listed under NT legislation or locally significant weed species. infestation introduced by CPs activities - Weed free certifications are provided for all vehicles, equipment and machinery moving from known areas of WoNS, weeds listed under NT legislation or locally significant weed infestation prior to attending a well location - Personnel inductions include specific requirements around weed hygiene

8.2.2 Land Management

Table 8-2 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for land management.

Table 8-2 Land Management Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant long-term impacts on soil stability, soil quality and land formations as a result of the drilling program	Erosion and sediment controls in place prior to the commencement of the regulated activity and working as designed	- Records show the erosion and sediment control plan implemented prior to the commencement of the activity - Records show all active work sites inspected for evidence of erosion and sedimentation, including after significant rain events, and that where erosion/sedimentation is identified, remedial actions are taken - The incident management system shows no incidents relating to the failure of ESCP controls (within the design parameters)
	No releases of contaminants (wastes, wastewater, chemicals, hydrocarbons or drilling fluids) resulting in long-term contamination of the soil	- Records show all spills remediated immediately on discovery, and where necessary contamination assessment undertaken. - The incident management system indicates no releases of contaminants incidents related to wet weather operations - The incident management system indicates no releases from the re-use, recycling, treatment, handling, storage of wastewater. - The incident management system indicates no releases of contaminant incidents related to a control failure of the wastewater management plan - The incident management system indicates no Level 3 spills as per the spill management plan - Records show emergency response plan implemented in the event of a Level 3 spill or leak
	Following conduct of the regulated activity, land not required for operational activities will progressively be returned to pre-disturbance conditions	- Records show progressive rehabilitation has been initiated for areas no longer required for operations - Annual rehabilitation report submitted - Corrective actions implemented on GAS score of -1 or -2 as recommended by a suitably qualified person in the annual rehabilitation report

8.2.3 Surface Water Management

Table 8-3 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for surface water management.

Table 8-3 Surface Water Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant impact on surface water quality as a result of the drilling program	No releases of contaminants (wastes, wastewaters, chemicals, hydrocarbons or drilling fluids) resulting in long-term contamination of surface waters	- Records show all spills remediated immediately on discovery, and where necessary contamination assessment undertaken - The incident management system indicates no releases of contaminant incidents related to wet weather operations - The incident management system indicates no releases from the re-use, recycling, treatment, handling, storage of wastewater. - The incident management system indicates no releases of contaminant incidents related to a control failure of the wastewater management plan - The incident management system indicates no Level 3 spills as per the spill management plan - Records show emergency response plan implemented in the event of a Level 3 spill or leak
	Erosion and sediment controls in place prior to the commencement of the regulated activity and working as designed.	- Records show the erosion and sediment control plan implemented prior to the commencement of the activity - Records show all active work site inspected for evidence of erosion and sedimentation, including after significant rain events, and that where erosion/sedimentation is identified, remedial actions are taken - The incident management system shows no incidents relating to the failure of ESCP controls (within the design parameters)
	Irrigation of treated effluent irrigation will not adversely impact surface water quality	- Records show effluent irrigation area designed in accordance with Department of Health, Code of Practice for On-site Wastewater Management (2014) - Record of approval from Department of Health for the use of the small sewage system - The incident management system indicates no irrigation during significant rainfall events

8.2.4 Groundwater Management

Table 8-4 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for groundwater management.

Table 8-4 Groundwater Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant impact on groundwater quality, levels and availability as a result of the drilling program	No releases of contaminants (wastes, chemicals, hydrocarbons or drilling fluids) resulting in long-term contamination of the groundwater	- Records show all spills remediated immediately on discovery, and where necessary contamination assessment undertaken - The incident management system indicates no releases of contaminants incidents related to wet weather operations - The incident management system indicates no releases from the re-use, recycling, treatment, handling, storage of wastewater. - The incident management system indicates no releases of contaminant incidents related to a control failure of the wastewater management plan - The incident management system indicates no Level 3 spills as per the spill management plan - Records show emergency response plan implemented in the event of a Level 3 spill or leak
	All aquifers defined by this EMP are isolated per the Code of Practice	- Records show a DITT approved WOMP implemented, which includes DITT approved casing and cement designs as committed to - Records shows no incidents against the approved WOMP that impact on aquifers defined by this EMP
	Groundwater extraction for the activity will not reduce groundwater availability to surrounding users	- Records indicate that only approved water sources used for water supply for EMP activities - Records indicate only existing CP bores used to extract groundwater as per the approved groundwater extraction licence - Records indicate CP does not exceed the groundwater extraction volume approved in the groundwater extraction licence

8.2.5 Air Quality Management

Table 8-4 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for air quality management.

Table 8-5 Air Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant impact to air quality at sensitive receptors as a result of the drilling program	No complaints in regard to dust generation by CP drilling activities	- The incident management system shows no evidence of vehicles travelling above the designated speed limit of 60km per hour on unsealed roads
Greenhouse gas emissions are minimised during the drilling program	No venting of hydrocarbons	- The incident management system shows no venting occurred during the activities - Records show methane emissions management plan implemented - Records show all pollutant and greenhouse gas emissions, including unplanned events and emissions from wastewater storage tanks are monitored/calculated and reported as per the requirements of NPI (i.e. when trigger thresholds are met) - Records show all flaring and unplanned venting recorded - Mass balance of actual greenhouse gas emissions calculated and reported to NGERS
	All leaks detected and repaired in accordance with the Code of Practice	- Records show methane emissions management plan implemented - Minor leaks rectified as per the Code of Practice within 30 days - Significant leaks are rectified as per the Code of Practice within 72 hours - The incident management system shows a log of all reported leaks

8.2.6 Fire Management

Table 8-5 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for fire management.

Table 8-6 Fire Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
Bushfires are not started as a result of conduct of the regulated activity and petroleum sites are protected from fires started outside of the work site	No uncontrolled bushfires caused by CPs drilling activities	- The incident management system shows no fires started as a result of CP activities - Records shows annual fire scar mapping, annual fire load estimates and maintenance of firebreaks are undertaken - Records show emergency response plan implemented in the event of a fire

8.2.7 Heritage Management

Table 8-6 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for heritage management.

Table 8-7 Cultural Heritage Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant impact to indigenous and non-indigenous artefacts, Aboriginal Sacred Sites, and non-indigenous heritage sites	No non-compliances with the AAPA certificate conditions or the CLC permit	- Records show all activities undertaken in accordance with the conditions of the relevant AAPA and CLC certificates - The incident management system shows no recorded incidents involving damage to Aboriginal sacred sites - Personnel inductions show requirements about location of known cultural and heritage sites, exclusion areas and process for unexpected finds
	No non-authorised disturbance of aboriginal archaeological places/objects and/or Aboriginal Sacred Sites	- The incident management system shows no recorded incidents involving damage to aboriginal archaeological places/objects and/or Aboriginal Sacred Sites - Records show chance find procedure implemented if artefacts located during clearing activities - Records show NT Police notified if human remains identified during clearing activities - No removal of artefacts in situ without prior approval from Heritage Branch NT

8.2.8 Community Management

Table 8-8 outlines the environmental outcomes, performance standards and measurement criteria that CP commit to under this EMP for community management.

Table 8-8 Community Environmental Outcomes, Performance Standards and Measurement Criteria

Environmental Outcome	Environmental Performance Standard	Measurement Criteria
No significant adverse impacts to the community as a result of conduct of the regulated activity	No complaints from identified stakeholders during conduct of the regulated activity	- Records show stakeholder consultation (i.e. communication log) ongoing during the activity. - Records show CP notification to local community in advance of planned flaring activities - Stakeholder communication log shows any complaints made in relation to conduct of the regulated activity are addressed - Personnel inductions show requirements about activities authorised during conduct of the regulated activity in accordance with land access agreements
	No complaints from the wider community in regard to traffic management during conduct of the regulated activity	- Records show transportation of over-width or over-dimension loads under approved NT Department of Transport permit - Records show DIPL approved traffic management plan implemented at each well location - The incident management system shows no evidence of incidents involving personnel driving on roads under the influence - Records of CP approved journey management plans to and from each well location
	All contractors informed of regulatory obligations in relation to the regulated activity in tendering information.	- CP contracting strategies include requirements for contractors to understand regulatory permits required relevant to the contracted activities - CP due diligence checks performed to demonstrate contractors have the appropriate licenses, permits or approvals prior to commencing works under the contract
	No complaints from the wider community in regard to visual amenity, noise or nuisance during conduct of the regulated activity	- Records show stakeholders alerted to flaring period via community engagement including notices on public notice boards and notifications in the paper - The incident management system shows no complaints made by community members in relation to noise, nuisance or visual amenity - Induction materials include information on tourism trails and camping areas relevant to each location. - Entry to each lease area clearly sign-posted - The incident management system shows no evidence of incidents involving unauthorised third-party access

9.0 Environmental Management System Implementation

9.1 Health, Safety, Security and Environment Integrated Management System

The feasibility, planning and assessment of the gas field development are undertaken within the framework of CP's Health, Safety, Security and Environment Integrated Management System (HSE MS), which incorporates environmental management. The key elements of the system include:

- Matching of legal obligations to the practical needs of all operations
- Assignment of responsibilities required to meet the commitments set out in the CP Health, Safety and Environment Policy
- Common measurement process to check that standards are complied with
- Encouragement of improvement in process and performance through feedback processes
- Appropriate and comprehensive documentary support
- Application of the system to all levels and areas of the organisation (including work by contractors), and to all working conditions and any activities that may have the potential to affect the health and safety of people or harm the environment.

The system has been constructed in a hierarchical manner, with the following tiers of documents shown in Figure 9-1.

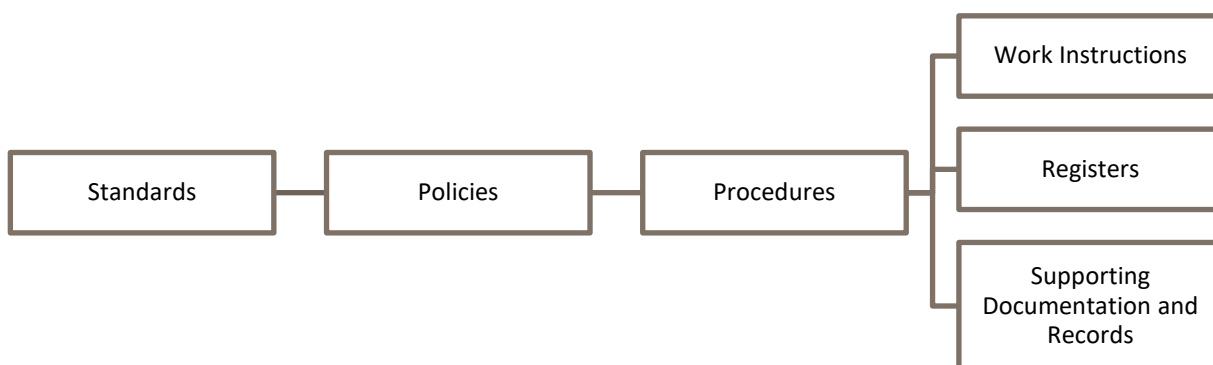


Figure 9-1 Document Hierarchy

To provide for a comprehensive HSE MS, the Standards outlined in Table 9-1 have been developed.

Table 9-1 HSE MS Structure

Standard	Management Element
Standard 1	Environment, Health and Safety Policies
Standard 2	Legal and Other Obligations
Standard 3	Objectives and Targets
Standard 4	Improvement Plans
Standard 5	Responsibility and Accountability
Standard 6	Training and Competency
Standard 7	Consultation and Communication
Standard 8	Document and Record Management

Standard	Management Element
Standard 9	Hazard Identification, Risk Assessment and Control
Standard 10	Contractor and Supplier Management
Standard 11	Operations Integrity
Standard 12	Management of Change
Standard 13	Emergency Preparedness
Standard 14	Monitoring, Measurement and Reporting
Standard 15	Incident Investigation
Standard 16	Management System Audit and Assessment
Standard 17	Management Review

9.2 Integrity Management

Asset integrity management is a key focus to ensuring the activities conducted under this EMP are done so in an effective and safe manner and is the basis for Standard 11 under the HSE MS. The asset integrity system under Standard 11 are depicted in Figure 9-2. The asset integrity system is under continual review with elements updated as required.

CP's approach to well integrity is consistent with section B4.1 of the Code of Practice.

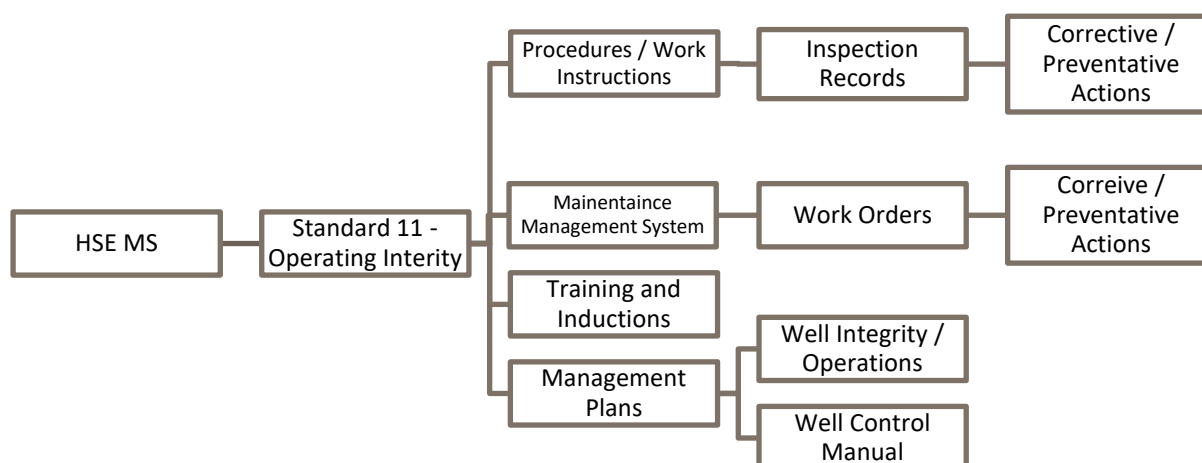


Figure 9-2 CP's Asset integrity system

International Standards Organisation (ISO) 16530-1:2017 Petroleum and natural gas industries – Well integrity – Part 1: Life cycle governance outlines methods to effectively manage well integrity through each phase of a well's life cycle. Among other phases, the life cycle governance defines the minimum requirements or recommendations for assessing well barriers prior to and after any well intervention/recompletions that involves breaking the established well barrier containment system.

CP's asset integrity system is consistent with ISO 16530-1:2017 and deals with the entire lifecycle of an asset, including recompletions, as well as procurement requirements relating to process containment, ignition control systems for protection, detection, shutdown and emergency response.

9.2.1 Procedures / Work Instructions

In addition to the management plans contained in this EMP, CP has procedures and work instructions developed for activities that are to be implemented during this EMP. The procedures / work instructions are:

- Fuel and chemical handling storage measures
- Ensure adequate spill clean-up material is located adjacent handling areas
- Chemical management procedure
- Inspection and maintenance of shut of valves
- Test and maintain function of vehicles, plant and equipment
- Spill response procedure
- Incident reporting and investigation procedure
- Reporting and management procedure
- NORM (Radiation) management plan
- Well Integrity Management Plans and Well Operations Management Plans (currently under development and will contain the information required under the Code of Practice and be approved by DITT)
- Review of well integrity management system
- Pressure inspections and monitoring

Where a test or inspection is performed on an asset it is recorded on a proforma / checklist and retained in CP's document management system for future reference.

The above procedures and work instructions are consistent with the requirements of the Code of Practice and this EMP.

9.3 Roles and Responsibilities

All field operations are managed by CP. The following subsections outline the responsibilities allocated to key personnel which are designed to ensure the environmental outcomes and performance standards within this EMP are achieved. The roles and responsibilities are slightly different for the type of wells being under this EMP drilled. An organisation chart is provided in Figure 9-3 for exploration wells and Figure 9-4 shows the organisation chart for development wells.

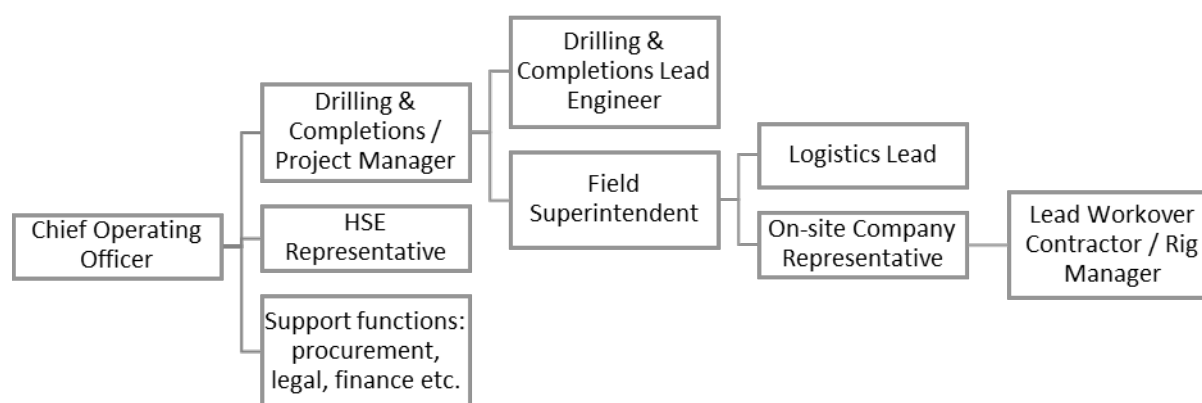


Figure 9-3 Organisation chart for exploration wells

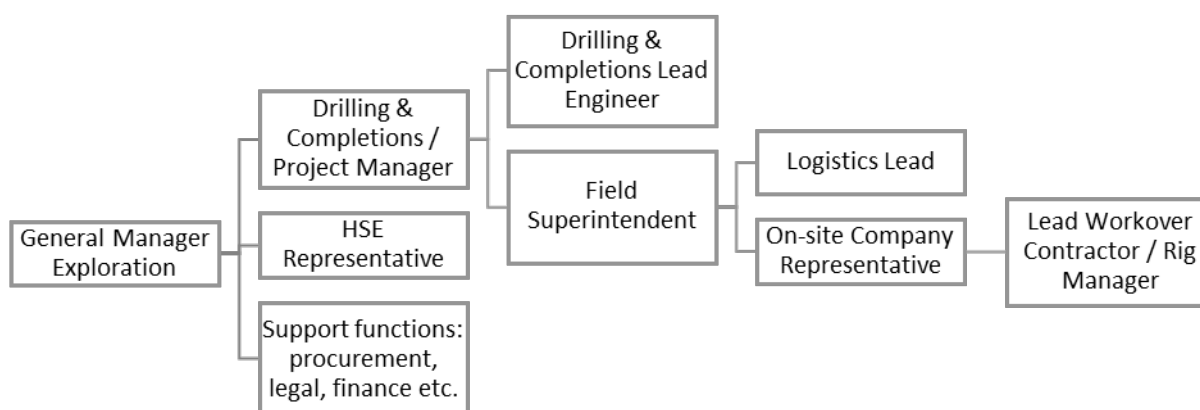


Figure 9-4 Organisation chart for development wells

9.3.1 General Manager of Exploration

It is the responsibility of the General Manager of Exploration to ensure that for the exploration wells identified in Table 1-1 :

- Are undertaken in accordance with this EMP, and reviews are undertaken as per the review schedule in the EMP
- Conformance with the CP HSE MS
- All permits and approvals to conduct activities under the EMP are obtained and complied with
- Internal and external compliance audits are conducted
- Personnel are appointed to investigate the merit of stakeholder objections / claims
- Environmental incidents are reported to the CP management team and (where required) to the regulator
- Contractor's health, safety and environment systems are compliant with CP's HSE MS and this EMP
- Appropriate communications are in place between CP, the landholder and other stakeholders to keep them informed of project issues and developments that may affect their activities.

9.3.2 Chief Operating Officer

It is the responsibility of the Chief Operating Officer to ensure that for the development wells identified in Table 1-1 :

- Are undertaken in accordance with this EMP, and reviews are undertaken as per the review schedule in the EMP
- Conformance with the CP HSE MS
- All permits and approvals to conduct activities under the EMP are obtained and complied with
- Internal and external compliance audits are conducted
- Personnel are appointed to investigate the merit of stakeholder objections / claims
- Environmental incidents are reported to the CP management team and (where required) to the regulator
- Contractor's health, safety and environment systems are compliant with CP's HSE MS and this EMP
- Appropriate communications are in place between CP, the landholder and other stakeholders to keep them informed of project issues and developments that may affect their activities.

9.3.3 Onsite Company Representative

It is the responsibility of the Onsite Company Representative to:

- Ensure that all aspects of the EMP are performed
- Ensure a site/project specific induction is conducted prior to any contractor commencing work on site
- Ensure a visitor induction is conducted prior to allowing any person who does not have work to perform on site to enter the site
- Notify General Manager of Exploration and Chief Operating Officer of any stakeholder objections or claims
- Undertake monitoring for bushfires and alert the HSE team and landholders as needed
- Ensure all hazards, incidents and near misses are promptly reported, investigated and appropriate corrective action completed
- Liaise with the drilling / flowline contractor when the Emergency Response Plan is activated
- Perform duties as outlined in the applicable emergency response plan if it is activated
- Maintain operating practices which meet CP's HSE MS standards.

9.3.4 HSE Team / Drilling and Completions Team

It is the responsibility of the HSE / Drilling and Completions Teams to:

- Work with the General Manager of Exploration, Chief Operating Officer and Onsite Company Representative to develop and implement procedures, work instructions, registers, forms and other documents to ensure on-ground works comply with the requirements of this EMP
- Work with the General Manager of Exploration, Chief Operating Officer and Onsite Company Representative to ensure contractor's health, safety and environment management systems comply with CP's HSE MS or a bridging document is in place and enforced
- Ensure that all new employees receive relevant corporate induction and training
- Provide ongoing training at site/s to ensure all personnel and contractors have the skills and knowledge to carry out assigned tasks in a safe and productive manner
- Ensure all employees and visitors comply with CP HSE MS policies and procedures
- Ensure compliance with all relevant legislative requirements
- Maintain operating practices which meet CP HSE MS standards
- Ensure all hazards, incidents and near misses are promptly reported, investigated and appropriate corrective action completed
- Identify potential hazards through regular workplace inspections and daily toolbox meetings and implement corrective action when required
- Encourage employee participation in safety/training programs and initiatives.

9.3.5 Contractors / Personnel / Visitors

It is the responsibility of the contractors / personnel / visitors to:

- Follow CP's procedures and work instructions
- Complete CP's registers, inductions and forms as required
- Encourage improvement wherever possible
- Promptly report all HSE hazards, incidents and near misses to their immediate supervisor
- Comply with CP HSE MS policies and procedures

- Ensure that work is not undertaken for which they feel they have not received adequate information and/or instruction
- Never undertake any task that does not meet CP's HSE MS standards
- Notify the Onsite Company Representative of any stakeholder objections / claims they receive
- Actively participate in CP HSE MS and training initiatives.

9.4 Training and Competencies

CP takes all steps to ensure ongoing training and awareness is conducted with all personnel and contractors. This enables CP, its workforce and contractors to cooperate effectively in developing and promoting measures to ensure a high level of HSE knowledge and compliance. Additional training will be provided on an as required basis.

CP's HSE MS training and awareness include:

- Compulsory site inductions
- Pre-start (Toolbox) meetings
- Routine HSE meetings and reports
- Shift handovers
- Dissemination and display of HSE related information.

A register of training and competencies for CP personnel and contractors is maintained for compliance with CP's management system for training and competency requirements

9.4.1 Site Inductions

Site inductions are compulsory and are the key mechanism CP employs to ensure all personnel, contractors and visitors are informed of CP HSE MS and this EMP including legislative responsibilities.

As a minimum, CP will ensure all personnel and contractors are trained in and are aware of the following CP systems:

- Wellsite permit to work system
- Job hazard analysis
- Remote communication equipment and procedures
- Emergency response plan
- Spill prevention
- Land disturbance
- Waste management
- Pest, plant and animal control
- Incident reporting
- Environmental awareness
- Speed limits
- Roles and responsibilities under this EMP.

Once approved, the EMP will be rolled out across the business by the Health Safety and Environment function. A copy of the EMP is available on site to all employees and contractors.

Visitors will receive a limited site induction that covers emergency response and this EMP. All visitors must be signed in and be accompanied by a CP representative at all times whilst on site unless a full site induction is provided.

A register of inducted CP personnel and contractors/visitors will be maintained for auditing purposes.

9.4.2 Pre-start (Toolbox) Meetings

A toolbox meeting will be held daily and prior to any change in activity commencing on the day of an activity occurring. These are designed for employees to discuss task HSE issues and specific requirements for the day's operations, including work permits.

The meeting is designed to discuss the following issues daily:

- Activities to be conducted during the next 24 hours
- Any hazards identified in the last 24 hours that may affect the work force or operations
- Any incidents or accidents that have occurred since the last pre-start meeting.

9.4.3 Shift Handovers

CP have developed and implemented a suitable handover procedure for shift changes and crew changes to ensure that relieving personnel are fully aware of their responsibilities and work status. Shift change handovers include the completion of checklists and other specified documentation. The handover checklist includes as a minimum:

- Any equipment damaged or out of service
- Status of current operations (inclusive of matters pertaining to the EMP)
- Any personnel or crew issues that the relief needs to be aware of
- Third party equipment or operation in the area.

9.4.4 HSE Related Information

CP makes relevant HSE information available by displaying on the HSE notice board available at each location. This may include:

- Policies and environment and safety management documentation
- Legislation, standards and guidelines
- Emergency contact information
- Appropriate signs being displayed relating to fire, safety and PPE requirements
- Emergency evacuation plans for the site
- Safety alerts and technical bulletins
- HSE minutes; from six monthly HSE meeting
- Emergency drill reports
- The Register and Closeout of Correcting Actions report.

9.5 Monitoring, Auditing and Management of Non-Compliance

9.5.1 Monitoring

The Onsite Company Representative is responsible for organising and reporting on all monitoring required under this EMP. Monitoring is supported by HSE personnel to ensure the management controls described in this EMP are implemented and that the performance measures are achieved.

Table 9-2 provides an overview of the monitoring activities to be undertaken

All equipment used for monitoring will be calibrated in accordance with manufacturer's specifications.

Table 9-2 Activities to monitor EMP effectiveness

Control	Monitoring	
	Action	Frequency
All		
Site inductions and training	Keep records of inductions and training to ensure 100% participation by all relevant personnel, contractors and visitors	For all new staff members and visitors before access to the site Annual review of training records
Job hazard analysis	Perform a job hazard analysis of any new task or new use of equipment	Prior to commencing new task or using new equipment
Weather monitoring	Monitor long-term and short-term weather forecast	Daily
Asset Integrity - Subsurface		
Gas extraction	Monitoring of wellhead pressure	Monthly
Asset Integrity – Wellsite production equipment and safety systems		
Gas processing	Routine testing, inspection and preventative maintenance program for each well	Per inspection regime within CP's maintenance management system
Flowlines	Hydrotest	Prior to commissioning
	Pressure monitoring	Continuous
Chemical and Hazardous Materials Management		
Storage of chemicals, fuel and oils	Routine visual inspection of storage areas to ensure no leaks or spills	As per Spill Management Plan
	Visual inspection of all secondary containment including all storage areas when in use during the wet season	As per Spill Management Plan
	Visual inspection to ensure adequate bunding and containment strategies implemented	As per Spill Management Plan
Spills and leaks of chemicals, fuel and oils	Routine emergency response drills	Monthly
Wastewater		
As per Wastewater Management Plan (refer Section 0)		
Waste Management		
Waste receptacles	Visual inspection of waste receptacles to ensure no fauna access to waste storage locations, lids are secure, waste are appropriately stored and there are no leaks	Weekly
Waste handling	Audit waste register to ensure all waste removal is appropriately captured and recorded	Quarterly
Erosion and Sediment Control		
Erosion and sediment	Visual site inspection to ensure appropriate	As per ESCP (refer Appendix 5)

Control	Monitoring	
	Action	Frequency
control	erosion and sedimentation control measures implemented	
Decommissioning and Rehabilitation Management		
Decommission and rehabilitation activities	Visual inspection of rehabilitation areas	Yearly
Decommission and rehabilitation activities	Photographic point monitoring before, during and after rehabilitation	As required before, during and after rehabilitation works
Biosecurity Management		
Weed-free certification	Weed free certificates when equipment and materials are mobilised to site from known weed infested areas	When equipment / materials are brought to site from known weed infested areas
Weed management	Inspection to identify weed outbreaks	Quarterly - Competent person Annual – Weeds Officer
Biodiversity Management		
Ecological assessment	Ecological surveys for flora and fauna	Prior to any ground disturbance activities
Monitor wastewater storages	Records kept in a fauna register of any fauna found in wastewater storages	During the routine inspections for wastewater. Frequency defined in the Wastewater Management Plan
Bushfire Prevention		
Fire control equipment	Inspect fire control equipment to ensure functionality	Bi-annual
Fire control	Inspect fire breaks	Annual
Air Quality Protection Measures		
Emissions	Maintenance records of vehicles and equipment	Per manufacturer's specifications
Flaring	Record of all flaring events	During operations as required
Dust	Monitoring of road conditions	Weekly
Traffic and Transport Management		
No unauthorised off-road driving, all drivers inducted into the potential impacts of off road driving on soil	Records kept of any incidents	During activities as required
Fauna strike	Records kept in a fauna register of any near misses or strikes	During activities as required
Zone designated speed limits	Records of any failures to comply and corrective action taken	During activities as required
Road conditions/road	Review: https://roadreport.nt.gov.au/home	During activities as required/after

Control	Monitoring	
	Action	Frequency
closures		rain falls
Appropriate licences for handling and transporting hazardous loads	Routine checks of licences	During activities as required
Community Impact Minimisation		
Complaints	Records of complaints from community in regards to activities	Records kept of any incident when applicable
Soil		
Soil contamination	Soil sampling directly after clean up at any location where spill/contamination has occurred Soil testing of any area of remediation following spill/contamination if applicable	As required, following incident, until soil is classified as remediated in accordance with the NEPM 2013 guidelines for contaminated sites
Surface Water		
Surface water contamination	Water/soil sampling directly after incident to determine extent of contamination and following removal of contamination source	As required, following incident, until soil/water is classified as remediated in accordance with the NEPM 2013 guidelines for contaminated sites and/or appropriate surface water guidelines

9.5.2 Auditing

In addition to regular monitoring as set out in Table 9-2, inspections and audits assessing compliance with this EMP will be undertaken by a suitably qualified person. System deficiencies, adverse or potentially adverse environmental conditions arising from site activities may be subject to the issue of environmental non-conformances. These non-conformances and the suitable corrective actions will be entered into the CP Event and Action Tracking System for tracking of action progress to closure.

As per Table 9-3, CP undertakes site inspections to assess conformance to the EMP. Assurance audits of implementation of the EMP commitments will be completed annually and included in the annual environmental report.

Table 9-3 EMP Audit Schedule

Audit Type	Scope of Audit	Frequency	Responsibility
Site Inspections	Checklists inspections of activities approved under this EMP. Items to be actioned as required	As per Table 9-2	HSE Representative, Site Supervisor, delegate or Environmental Consultant
Annual Assurance	Compliance against EMP commitments and risk management controls	Annually	HSE Representative or Environmental consultant

9.5.3 Continuous Improvement

CP is committed to continual improvement in its HSE performance and develops improvement plans in accordance with HSE Management Standard 4 – Improvement Plans (IP). The content of a HSE Improvement Plan supports:

- Strategic improvement initiatives
- Actions necessary to address compliance deficiencies and audit findings (including from the inspections and audits required under the EMP)
- Opportunities to improve environmental outcomes, reduce key risks and improve environmental performance through changes in process, new technologies and/or changes in implementation of an activity to meet CP's environmental objectives.

9.5.4 Incident and Non-conformance Management

CP's incident management procedures are designed to:

- Ensure all near misses and incidents are reported in a standard format so that consistency and accuracy of the process is maintained
- Identify the underlying and basic causes of all near misses and/or incidents
- Implement mechanisms to prevent the recurrence of similar near misses/incidents
- Provide information to prepare the CP near miss/incident statistics
- Identify potential losses and suitable corrective actions.

It is CP's policy to report and investigate near misses, major hazards and incidents and to implement action to mitigate any identified contributing factors.

Incident management procedures are detailed in the CP HSE MS.

Environmental incidents that may arise during activities under this EMP include:

- Well control event
- Well integrity failure
- Petroleum, grey water, chemical or sewerage spills (including uncontrolled escapes)
- Introduction and spread of weeds, invasive species or flora and fauna diseases
- Fauna injury/fatality
- Uncontrolled fire
- Clearing of threatened flora species
- Clearing of threatened fauna species habitat
- Disturbance to heritage areas.

All environmental incidents and near misses that arise due to the presence of hazards on site are reportable to CP management for inclusion in the incidents/near misses register. External reporting will follow the requirements set out in Section 10.0.

9.6 Emergency Preparedness

CP's emergency planning includes:

- Emergency response plan, manual and procedures
- Dedicated trained emergency response personnel
- Dedicated emergency response vehicles and equipment
- Emergency simulation training exercises (drills); and
- Preventative maintenance programs.

Types of emergency situations that may arise during activities under this EMP include:

- Spills
- Fire or explosion
- Well control failure.

CP has an overarching Emergency Management Plan under its HSE MS that provides the minimum requirements across CPs operations. The Emergency Management Plan is supplied in Appendix 8.

Once a contractor is selected for the drilling campaign, the contractor will develop a site specific Emergency Response Plan that will include each of the drilling locations. CP and the contractor will work together to create a bridging document between the Emergency Management Plan and the Contractors Emergency Response Plan. This will ensure that the requirements of the CP Emergency Management Plan are met and that CP and the contractor are succinct in responding to incidents.

CP will ensure all personnel, contractors and visitors are aware of the emergency response framework and are adequately trained in emergency response procedures relevant to their role/position.

CP's Emergency Response Plan, manuals and procedures are reviewed and updated to incorporate new information arising from incidents, near misses and emergency simulation training sessions.

9.7 Record Keeping

The list of environmental records that will be kept for each well lease includes:

- Induction records
- Waste stream records including type, quantity and disposal method
- Incident register
- Hazardous materials manifests and records of all chemicals stored on site
- Visual spill monitoring (refer Table 7-7) results
- Diesel fuel usage
- Weed species control efforts
- Nature, location and extent of disturbance of flora and fauna
- Geospatial information depicting cleared areas
- Non-compliances and corrective action records
- Internal audits and inspection records
- External audits
- All maintenance records
- Site access register
- Water usage
- Flared gas volumes
- Volume of water used in dust suppression
- Environmental survey and sampling work results.

Environmental records will generally be retained for a minimum period of five years. To the extent any of these records are 'prescribed records' for the purpose of the *Petroleum (Environment) Regulations 2016*, they will be kept for the longer of five years following the period during which the petroleum interest is in force or 15 years after the record comes into existence.

10.0 Reporting

10.1 Incident Reporting

Internal incident management and reporting requirements are outlined in Section 9.

All required incident reports shall be made formally in writing to external stakeholders with copies sent to applicable CP managers, with incident details registered into the database.

10.1.1 Reportable Incidents

For environmental incidents, that occur and are not within the scope of this EMP, (e.g. an incident that occurs on a road not under the control of CP) as defined under Section 14 of the *Waste Management and Pollution Control Act*, CP will report to the NT EPA on their Pollution Hotline 1800 064 567 as soon as possible (at most within 24 hours).

Under the Petroleum (Environment) Regulations 2016, a reportable incident means an incident arising from a regulated activity that has caused, or has the potential to cause, material environmental harm or serious environmental harm as defined under the *Petroleum Act 1984*, Division 2.

In this case, CP will notify (this may be oral or in writing) the Minister of a reportable incident as soon as practicable but no later than 2 hours after the first occurrence of the incident or after the time CP becomes aware of the incident (if orally notified a written notification must follow within 24 hours). The contact number for phone notifications is 1300 935 250.

The notification will include at a minimum:

- Details of the interest holder
- All material facts and circumstances
- Information about any action taken to avoid or mitigate material environmental harm
- Information about the corrective action that has been taken.

If it is confirmed that the incident is a reportable incident, a written report must be submitted within three (3) days. The report will contain:

- All material facts and circumstances about the incident and the results of any investigations
- The nature and extent of the material environmental harm
- Information about any corrective actions necessary to prevent re-occurrence of a similar incident
- Any actions taken, or proposed to be taken to rehabilitate an affected area
- Details and timing of any further corrective actions required (such as a full root cause analysis and investigation).

In addition, CP will provide a final report about a reportable incident 30 days after the clean up or rehabilitation of the area affected by the reportable incident is completed.

The final report must include a comprehensive and detailed root cause analysis of the reportable incident. At no longer than 90-day intervals, progress reports will be submitted about the incident investigation and steps taken to mitigate any environmental harm.

10.1.2 Recordable Incidents

The *Petroleum (Environmental) Regulations 2016* define a recordable incident as an incident that is not a reportable incident and arises from the activity that:

- Has resulted in an environmental impact or environmental risk not specified in the EMP or
- Has resulted in a contravention of an environmental performance standard specified in the EMP or

- Is inconsistent with the environmental outcomes specified in the EMP and
- Is not a reportable incident.

CP will maintain a register of recordable incidents and report them to the DEPWS in accordance with section 35 of the *Petroleum (Environment) Regulations 2016*.

10.1.3 Summary of Reporting and Notification Requirements

Table 10-1 provides a summary of CP's reporting and notification requirements for the drilling program. CP have identified the reporting requirements and the regulator/stakeholder to whom reports or notification should be made along with the information to be provided. CP maintains a register internally of key regulator contact details which is reviewed and updated regularly.

Table 10-1 Summary of reporting and notification requirements

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
Commencement of the activity	Petroleum (Environment) Regulations 2016 Schedule 1, item 12	Interest holder must notify the Minister, occupier of the land and owner of the land on which the activity is to be carried out before commencement of activity.	DEPWS CLC	- Date of commencement of activity to be notified prior to commencement
Reportable incidents	Petroleum (Environment) Regulations 2016 s 33	DEPWS is to be notified of reportable incidents within 2 hours of the interest holder becoming aware of the incident, or within 2 hours of the incident occurring. A written report must be provided within 24 hours if the initial report was made orally.	DEPWS	- CP contact details - All material facts and circumstances about the incident that CP knows/is able to find out - Action taken to avoid/mitigate harm - Corrective action taken, or proposed to be taken to prevent similar incident
Reportable incident involving a spill which triggers the emergency response plan	Petroleum (Environment) Regulations 2016 s 33 Waste Management and Pollution Control Act 1998 (NT) s 14 EMP s 7.5.7	DEPWS is to be notified of reportable incidents within 2 hours of the interest holder becoming aware of the incident, or within 2 hours of the incident occurring. A written report must be provided within 24 hours if the initial report was made orally. Duty to notify the NT EPA as soon as practicable but within 24 hours of any incident which occurs which causes or threatens to cause pollution resulting in material or significant environmental harm Landholders to be notified within 24 hours of the ERP being triggered	DEPWS EPA CLC	- CP contact details - All material facts and circumstances about the incident that CP knows/is able to find out - Action taken to avoid/mitigate harm - Corrective action taken, or proposed to be taken to prevent similar incident

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
Reportable incident reports	Petroleum (Environment) Regulations 2016 s 34	Initial report on a reportable incident to be provided to DEPWS as soon as practicable and within 72 hours of the event occurring. A final report must be provided to DEPWS within 30 days after remediation/clean-up of the affected area, but within 90 days of the initial report unless otherwise agreed.	DEPWS	- Results of any assessment/investigation (root cause analysis) of conditions/circumstances that caused or contributed to the occurrence of the incident, including assessment of effectiveness of the designs, equipment, procedures, management systems that were in place to prevent the occurrence of an incident of that nature - Nature and extent of harm that the incident caused/had potential to cause - Actions taken, or proposed to be taken to clean-up or rehabilitate the affected area - Action taken, or proposed to be taken, to prevent reoccurrence of similar incident
Recordable incident reports	Petroleum (Environment) Regulations 2016 s 35	A written report of all recordable incidents must be provided to DEPWS not later than 15 days after the 90-day reporting period (unless otherwise agreed).	DEPWS	- A record of all recordable incidents that occurred during the reporting period - All material facts and circumstances concerning the recordable incidents that CP knows - Action taken to avoid or mitigate impacts and risks of the incidents - Corrective action taken or proposed to be taken to prevent similar incidents
Incidents of actual or potential	Waste Management and Pollution	Duty to notify the NT EPA as soon as practicable but within 24 hours of any incident which occurs which	EPA	- Name of the site - Location

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
material or serious environmental harm involving pollution	Control Act 1998 (NT) s 14	causes or threatens to cause pollution resulting in material or significant environmental harm		- Description of the pollution/potential pollution that has occurred including description of the impact - Who discovered the pollution /potential pollution - Who caused the pollution /potential pollution - Whether any actions were taken to try to stop the pollution /potential pollution from being caused, and by whom - Future actions/remediation
Discovery of an Aboriginal archaeological place and/or object	Heritage Act 2011 s 114	A person who discovers a place or object the person knows is an Aboriginal archaeological place or object, must as soon as practicable after the discovery, but within 7 days, provide a written report to the CEO.	DEPWS Heritage Branch	- A description of the place and object - Its location - The person's name and address - The name and address of the owner or occupier of the place or place where the object is located
Incident involving damage to an Aboriginal archaeological place and/or object	None applicable	CP will notify the Heritage Branch as soon as practicable but within 7 days in the event of damage/interference with an Aboriginal archaeological place or object that is not covered by a work approval	DEPWS Heritage Branch	- Name of the site - Location - Damage that has occurred - Who discovered the damage - Who caused the damage - If anyone has witnessed the damage being caused - Whether any actions were taken to try to stop the damage from being caused, and by whom
Incident involving damage to an	Aboriginal Sacred Sites Act 1989	CP will notify AAPA as soon as possible, but within 72 hours, in the event of damage to an Aboriginal Sacred Site	AAPA	- Name of the site - Location - Damage that has occurred

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
Aboriginal Sacred Site				- Who discovered the damage - Who caused the damage - If anyone has witnessed the damage being caused - Whether any actions were taken to try to stop the damage from being caused, and by whom - Whether the site is still under threat from further damage
Incident involving EPBC protected matters	Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 199, s 214, s 256	If a person who undertakes an activity that results in the unintentional death, injury, trading, taking, keeping or moving of a member of a listed threatened species (except a conservation dependent species), a member of a listed threatened ecological community, all cetacean (whale, dolphin or porpoise) species, a member of a listed migratory species, or a member of a listed marine species in or on a Commonwealth area and the activity was not authorised by a permit, then Secretary of the Department must be notified within 7 days of the person becoming aware of the results of the activity.	DAWE	- Name of the site - Location - Interference that has occurred and description of the protected matter impacted - Who discovered the interference - Who caused the interference - If anyone has witnessed the interference being caused - Whether any actions were taken to try to stop the interference from being caused, and by whom
Incident involving fire spreading offsite	Bushfires Management Act 2016 (NT) s 90	If the owner or occupier of the land is unable to control a fire on the land, the owner or occupier must take all reasonable steps to notify a fire control officer or fire warden, and the occupier of any land to which the fire is likely to spread or a person apparently over the age of 16 years present on that land	Bushfire NT CLC Neighbouring land-holders	- Description of the fire threat to the CP site and adjacent lands
Presence of notifiable plant or weed	Weeds Management Act 2001 (NT) s 29	When given notice by the Minister, land occupiers and landowners have a duty to notify the Minister of the presence of a plant, declared weed or potential weed on the land within the time specified in the notice	DEPWS Weed Management Branch	- Presence of notifiable plant/weed - As per conditions of the notice by the Minister

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
Annual Environment Performance Report (AEPR)	Petroleum (Environment) Regulations 2016 Schedule 1, item 11(2)	Environment performance report to be submitted annually	DEPWS	- AEPR as per the AEPR Template provided by the Northern Territory Government (May 2020, Version 0 or as amended)
Vegetation clearing	Code cl A.3.5	Geospatial information depicting areas cleared is to be provided to the Minister	DEPWS	- Geospatial information on cleared areas
Weed survey	Code cl A.3.6 (b)	Annual weed survey provided to DEPWS	DEPWS	- Annual weed survey report
Wastewater tracking	Code cl C.6.1(d)	Wastewater tracking documentation must be reported to the Minister at least annually in accordance with the framework (Spill Management Plan and Wastewater Management Plan) outlined in the EMP	DEPWS	- Wastewater tracking documentation
National Pollution Inventory (NPI) annual reporting	National Environment Protection (National Pollution Inventory) Measure 1998 (Cth) s 9 Waste Management and Pollution Control Act 2003 (NT)	The occupier of each reporting facility is to be required to provide information to the NPI if a reporting threshold for a substance is exceeded	DAWE NPI	- Annual NPI emissions estimates
Greenhouse and energy reporting – National	National Greenhouse and Energy Reporting Act 2007 s 19	A registered corporation must provide a report to the Greenhouse and Energy Data Officer relating to the greenhouse gas emissions, energy production and energy consumption from the operation of facilities under the operational control of the corporation and entities that are members of the corporation's group, during that financial year	Clean Energy Regulator	- Annual NGER emissions estimates
Greenhouse and energy reporting – NT	Code cl D.6.2	Report NGER emission estimates to the NT government	DEPWS	- Annual NGER emissions estimates plus emissions that do not meet the NGERS reporting threshold

Reporting & Notification Topic	Legislation/ Reference	Requirement	Agency / Stakeholder	Information to be Provided
Flaring	EMP s 8.2	Local communities notified of flaring and CP contact numbers through signage at public notice boards	NA	- Time, date, location and duration of proposed flaring - CP contact details
Venting	EMP s 7.6.6	CP to notify DITT and DEPWS in the event of any flaring	DITT DEPWS	- Time, date, location and duration of venting
Flaring and venting emissions	Code cl D5.9.2(c), D5.9.4(b)	Emissions from flaring, venting (and other events) and other sources during exploration, well construction must be measured and reports submitted. These emissions should be measured using methods consistent those specified under the National Greenhouse and Energy Reporting (Measurement) Determination 2008	DEPWS	- Emissions from flaring and venting as measured using NGER methods
Methane leak detection surveys	Code cl D.6.2(e).	Annual report to include results of leak detection surveys	DEPWS	- Extent of compliance with this plan - Summary of monitoring undertaken during the period - Summary of minor and significant leaks identified during the reporting period, including the date of identification and repair for each leak and those leaks which could not be repaired - Explanation of why any component could not be repaired and what actions will be taken to either decommission the component or remedy the situation
EMP close-out	Petroleum (Environment) Regulations 2016 s 14	A current EMP remains in force until CP notifies the Minister the activity is no longer being carried out and all of the environmental outcomes and obligations under the plan have been met, and the Minister advises the interest holder the notice is accepted and the plan ceases to be in force.	DEPWS	- Date the activities are due to be completed, prior to the activities being completed

10.1.4 Annual Environmental Performance Report

An Annual Environment Performance Report (AEPR) is required under the Petroleum Environment Regulations 2016. The AEPR outlines the environmental performance of CP with respect to the EMP activities. Specifically, the AEPR provides for an assessment of whether CP has met the environmental outcomes and environmental performance standards included in the approved EMP. The content of the AEPR for this EMP will follow the content and structure requirements as provided in the AEPR Template by the NT Government (May 2020, Version 0 or as amended)

11.0 Stakeholder Engagement and Consultation

11.1 Stakeholder Engagement

CP is part of the Central NT community and has established and maintained enduring and mutually beneficial relationships; ensuring that our activities generate positive economic and social benefits for and in partnership with these communities.

To continue to foster those relationships, CP has engaged with a range of stakeholders and interested parties. However, for the purpose of this EMP, CP identified its stakeholders, in compliance with the *NT Petroleum (Environment) Regulations 2016* as:

- Traditional Owners recognised as the Native Title holders and / or claimants and their representatives, the Central Land Council; and
- Pastoralists recognised as the landholders of the two pastoral Lease Stations which are impact by the drilling at Orange Creek station and Owen Springs East Station.

CP also recognises and is planning to or has engaged, where appropriate and acceptable, with the following interested parties including:

- Community
- Landholders
- Government
- Other key non-commercial external stakeholders (e.g. industry bodies, non-government organisations)
- Industrial relations stakeholders
- Other commercial external stakeholders

Due to COVID restrictions and the establishment of NT government enforced bio-security areas across the NT during the first half of 2020 which restricted access to communities, CP have been unable to fully execute our planned formal stakeholder engagement process which included face to face meetings set up in March 2020 involving all key stakeholder groups. At these planned meetings CP was in accordance with *NT Petroleum (Environment) Regulations 2016* aiming to provide a comprehensive overview of our environmental management plan which included:

- The activity the CP proposes to carry out
- The locations of the activities
- The anticipated environmental impacts and environmental risks of the activity
- The proposed environmental outcomes in relation to the activity
- The possible consequences of carrying out the activity to the stakeholder's rights or impacts on stakeholders activities.

These planned meetings have now been rescheduled for October and November 2020 using a mix of online and face to face. Given the access and limitations with technology in some of these communities these new meetings have taken longer to organise than expected.

Despite the COVID restrictions, during the development of this environmental management plan CP has engaged with its stakeholders (or their representative) as outlined in the Communications Log in Appendix 9.

Communication with stakeholders to date has focused on our program and the environmental management plan. The engagements included discussions to access the land for environmental studies, locations of the proposed locations to understand the impacts of the wells on the stakeholders, Sacred Site Clearances, land access agreements and commitments to work together to get the mutually agreed outcome. These engagements have been made through:

- Native Title Representative Body meetings and briefings
- Face to face meetings
- Phone calls and video conferencing, and
- Presentations

11.2 Landowner Engagement

CP has engaged with the Landowners on an ongoing basis in regard to the project described in this EMP. The key engagements with the landowners have centred around:

- The drilling activities to be undertaken on the properties and proposed locations. This includes a discussion on the impacts to the pastoral operations which includes
- Agreeing on the proposed locations and access tracks to minimise the impacts
- Impacts to cattle grazing during the operations and other key environmental risks and outcomes to be achieved
- Discussions about the activities to be undertaken on the property and the possible consequences in relation to:
 - Land disturbance,
 - Groundwater use,
 - Ecology surveys and weed management,
 - Emissions including; noise, light, dust and flaring, and
 - The proposed mitigations in the environmental management plan.
- Access to the proposed locations for environmental studies for the inclusion in this environmental management plan
- Early engagement on compensation for the impacts of the project on pastoral operations.

11.3 Traditional Owner(s) Engagement

CP has engaged with the Traditional Owners outside of the formal facilitated process through the CLC. Engagement with CLC and TOs has been hampered by COVID-19, but communication prior to and during COVID-19 restrictions was undertaken via telephone and video conference where practical and has focused on:

- The drilling activities to be undertaken on country and proposed locations, key environmental risks and outcomes to be achieved
- Discussions about the activities to be undertaken on the property and the possible consequences in relation to:
 - Land disturbance
 - Groundwater use
 - Ecology surveys and weed management
 - Emissions including; noise, light, dust and flaring
 - The proposed mitigations in the environmental management plan
- Their understanding of the nature and purpose of activities, which is to be executed by the CLC in accordance with the Land Rights Act
- The outcomes of the Aboriginal sacred site survey completed as part of this environmental management plan
- Planning and execution of on country meetings to discuss the drilling program and complete the Sacred Site Clearance and avoidance surveys of land with the CLC.

Traditional owners are aware of the planned activities, the locations and have been to site with AAPA and the CLC to clear the impacted areas. The AAPA certificate applications are either approved or currently being assessed for the activities described in this 2020-21 drilling environmental management plan:

- 202000418 – Palm Valley 12 Exploration Well (approved)
- 202000411 - West Mereenie Development Wells (currently being assessed)
- 202000526 - Orange Exploration Well (approved)
- 202000435 - Mamlambo Exploration Well (approved)
- 202000442 - Dingo Exploration Wells (approved).

Due to the difficulties of COVID-19, traditional engagement has been challenging. CP is in weekly conversations with the CLC to ensure that engagement is fulfilled and both parties are satisfied with the outcomes.

11.4 Central NT Community Consultation

CP also recognises that the project indirectly impacts other interested parties and where appropriate has engaged informally with:

- Local communities
- NT Local and State Government agencies
- Peak bodies
- AAPA
- Local businesses
- Central Land Council
- Landowners / Lease holders.

CP undertook a consultation program between 25-29 November 2019 to provide an overview of its anticipated drilling program for 2020-21.

A copy of the PowerPoint presentation and a summary of each of the consultations is provided in Appendix 9.

11.5 Stakeholder Engagement Planned to Occur

The formal CLC organised Liaison Committee Meeting for the Mereenie field and the development wells (WM27 and WM28) was undertaken in October. All the remaining Liaison Committee Meetings are planned to be held in November 2020, where all the landowners / leaseholders identified in this EMP will be invited to attend. CP will attend this meeting and provide a further update on the status of the drilling campaign and will include further information about:

- The activity the CP proposes to carry out
- The locations of the activities
- The anticipated environmental impacts and environmental risks of the activity
- The proposed environmental outcomes in relation to the activity
- The possible consequences of carrying out the activity to the stakeholder's rights or impacts on stakeholders activities.

Notifications will be made prior to commencement of drilling in each tenure to the relevant stakeholders.

Specific to Palm Valley-12 CP will consult with the community of Hermannsburg prior to drilling the well to inform them about the potential for light emissions from flaring as part of the drilling activity,

which could be visible from parts of the community. This will be done via community sessions, public notice boards and notifications in the local paper.

11.6 Record of Communications

CP maintains a record of all ongoing interactions and communications with stakeholders and affected parties in relation to activities under this EMP. This information is maintained in a Communication Log and is Appendix 9. The communication log records the following details:

- Date
- Topic discussed
- Type of engagement
- CP contact
- Primary stakeholder
- Outcomes – Any issued resolved or identified.

In addition to the communication log, during the period of the EMP, CP will also record the following:

- Copy of information provided to any stakeholder
- If written responses have been received by any stakeholders, a summary and copy of each response
- An assessment of the merits of any objection or claim made by a stakeholder about the anticipated environmental impact of the proposed activity
- A statement of CP's response to each objection or claim made by a stakeholder
- Details of changes made by CP as a result of stakeholder engagement.

11.7 Assessment of Merit of Stakeholder Objection or Claim

If during the regulated activities CP receives a stakeholder complaint or objection the following process will be undertaken to assess the claim and ensure it receives the appropriate attention. The process outlines:

- All stakeholder objection / claims are to be provided to the General Manager of Exploration (in relation to exploration wells) or the Chief Operating Officer (in relation to any other matter)
 - General Manager of Exploration / Chief Operating Officer to appoint a person to confirm that the objection / claim relates to the activities under this EMP
- General Manager of Exploration / Chief Operating Officer to notify the stakeholder of the results of the above findings (this will generally be via written communication)
 - If the results confirm that the objection / claim is not related to CP no additional action is required by CP
 - If the results confirm that the objection / claim is related to CP follow the remaining dot points
- General Manager of Exploration / Chief Operating Officer to appoint a person to investigate the stakeholder objection / claim
- Person appointed to investigate the objection / claim is to investigate and provide a documented report to the General Manager of Exploration / Chief Operating Officer
- Once the report is accepted by the General Manager of Exploration / Chief Operating Officer, they will provide a response to the stakeholder that reflects the outcomes of the investigation (including any actions that CP have/will undertake to address the objection / claim – if required)
 - This response will generally involve a verbal discussion with the stakeholder on the outcomes of the investigation and be followed up with written correspondence. The General Manager of

Exploration / Chief Operating Officer will determine the appropriate method to respond to each stakeholder.

No stakeholder objection or claims have been made through the Stakeholder engagement thus far.

11.8 Details of Changes Due to Engagement

Any changes in operations, policy or procedures because of stakeholder consultation or other engagement will be recorded in writing. CP Management will review and assess any changes for merit and if deemed necessary to be undertaken these changes will be approved by CP management before any action is taken. Where required, CP management will submit details of the proposed changes to the regulator for approval. A summary of any changes to operations that derive from stakeholder consultation or other engagement will be included in the annual environmental report and reflected in future versions of this EMP.

12.0 References

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Appendices