



## NT Exploration Permit 161

# Tanumbirini North Water Bore Monitoring Program

## ENVIRONMENT MANAGEMENT PLAN

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## Distribution of Controlled Copies

#	Name	Company / Organisation	Position
1	David Close	Santos	Exploration Manager – Onshore NT, QLD & NSW
2	Charles Dack	Department of Primary Industries and Resources	Environmental Engineer
3	Louis Gomas	Department of Primary Industries and Resources	Senior Director
4	James Pratt	Department of Primary Industries and Resources	Executive Director
5	TBC	Water Bore Drilling Contractor	Manager

## Table of Contents

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	Scope of this Environmental Management Plan .....	1
1.2	Titleholder details .....	1
1.3	Corporate environment policy .....	3
<b>2.0</b>	<b>ENVIRONMENT LEGISLATION AND OTHER REQUIREMENTS .....</b>	<b>4</b>
2.1	Key Legislation Overview .....	5
2.2	Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory .....	9
2.3	Relevant Agreements and Operating Consents .....	10
2.4	Codes of Practice and Relevant Guidelines .....	10
2.5	Further referral of the project .....	11
<b>3.0</b>	<b>DESCRIPTION OF THE ACTIVITY .....</b>	<b>15</b>
3.1	Activity Overview .....	15
3.2	Location .....	15
3.3	Timing and Personnel .....	18
3.4	Water Bore Program Specifications .....	18
3.5	Water Bore Lease Pad .....	18
3.6	Road Access .....	20
3.7	Drilling Fluids .....	20
3.8	Figure Operations Support Facilities .....	21
3.9	Planned and Unplanned Activities .....	21
3.10	Closure .....	22
<b>4.0</b>	<b>DESCRIPTION OF EXISTING ENVIRONMENT .....</b>	<b>23</b>
4.1	Natural environment .....	24
4.2	Baseline water conditions .....	28
4.3	Biodiversity .....	32
4.4	Cultural Environment .....	39
4.5	Socioeconomic environment .....	40
4.6	Key environmental values and sensitivities .....	40
<b>5.0</b>	<b>OVERVIEW OF THE ENVIRONMENTAL RISK ASSESSMENT PROCESS .....</b>	<b>43</b>
5.1	Process Overview .....	43
5.2	Identification of Environmental Aspects .....	44
5.3	Identification of the environment that may be affected .....	44
5.4	Identification of Particular Values and Sensitivities .....	44
5.5	Identification and Evaluation of Potential Environmental Impacts .....	44
5.6	Pre-treatment Risk Ranking .....	44
5.7	Control Measure Identification and ALARP Decision .....	44
5.8	Determination of Severity of Consequence .....	47

5.9	Determination of Likelihood .....	48
5.10	Residual Risk Ranking .....	48
5.11	Determination of Impact and Risk Acceptability .....	49
<b>6.0</b>	<b>ENVIRONMENTAL RISK ASSESSMENT .....</b>	<b>51</b>
6.1	Section overview .....	51
6.2	Planned activities.....	51
6.3	Unplanned activities .....	65
6.4	Principles of Environmentally Sustainable Development .....	90
<b>7.0</b>	<b>ENVIRONMENTAL OUTCOMES, PERFORMANCE STANDARDS, MEASUREMENT CRITERIA</b>	<b>91</b>
<b>8.0</b>	<b>IMPLEMENTATION STRATEGY .....</b>	<b>102</b>
8.1	Santos EHS Management System.....	102
8.2	Roles and Responsibilities .....	103
8.3	Training and Competencies.....	104
8.4	Emergency Response Plan .....	105
8.5	Management of Change .....	105
8.6	Incident Reporting .....	106
8.7	Environmental Performance Monitoring and Reporting.....	107
<b>9.0</b>	<b>STAKEHOLDER ENGAGEMENT .....</b>	<b>110</b>
9.1	Ongoing Consultation.....	110
<b>10.0</b>	<b>REFERENCES.....</b>	<b>112</b>

## Tables

Table 1-1	Details of Titleholder and Nominated Liaison Person.....	1
Table 2-1:	Key relevant Commonwealth and Northern Territory legislation.....	5
Table 2-2:	NTEPA Environmental Factors and Objectives Assessment.....	12
Table 3-1	location of lease pad centre point.....	15
Table 4-1	Environmental values and/or sensitivities with the potential to occur in the vicinity of the project .....	23
Table 4-2	Temperature and rainfall records for BoM Station #014704 .....	24
Table 4-3	Percentage of land systems and total area within the project area .....	26
Table 4-4	Status of knowledge about shallow aquifers .....	30
Table 4-5	Priority weeds within the Katherine Region Weed Management Plan.....	37
Table 5-1:	ALARP Decision Making based upon Level of Uncertainty .....	45
Table 5-2	Santos Hierarchy of Control.....	47
Table 5-3	Santos Environmental Consequence Classification .....	47
Table 5-4	Santos Likelihood Descriptors .....	48
Table 5-5	Santos Risk Matrix .....	49

Table 5-6 Santos Risk Significance Rating.....	49
Table 6-1 Summary Table Aspects and Receptors for Planned Activities .....	51
Table 6-2 Physical Disturbance Receptor risks and impacts.....	52
Table 6-3 Physical Disturbance Pre-treatment risk ranking.....	54
Table 6-4 Controls to reduce risk and impacts of Physical Disturbance .....	54
Table 6-5 Physical Disturbance Residual Risk Ranking .....	57
Table 6-6 Atmospheric Emissions Receptor risks and impacts.....	58
Table 6-7 Atmospheric Emission Pre-treatment risk ranking.....	59
Table 6-8 Controls to reduce risk and impacts of atmospheric emissions .....	59
Table 6-9 Atmospheric Emissions Residual Risk Ranking .....	61
Table 6-10 Noise Receptor risks and impacts.....	62
Table 6-11 Noise Pre-treatment risk ranking.....	63
Table 6-12 Controls to reduce risk and impacts of Noise Emissions .....	63
Table 6-13 Noise Residual Risk Ranking .....	64
Table 6-14 Summary Table Aspects and Receptors from Unplanned Activities .....	65
Table 6-15 Fauna Interaction Receptor risks and impacts .....	67
Table 6-16 Fauna Interaction Pre-treatment risk ranking.....	67
Table 6-17 Controls to reduce risk and impacts of Fauna Interaction .....	68
Table 6-18 Fauna Interaction Residual Risk Ranking.....	69
Table 6-19 Erosion Receptor risks and impacts.....	70
Table 6-20 Erosion pre-treatment risk ranking .....	71
Table 6-21 Controls to reduce risk and impacts of Erosion .....	72
Table 6-22 Erosion Residual Risk Ranking .....	74
Table 6-23 Introduced Pest and Pathogens Receptor risks and impacts .....	75
Table 6-24 Introduced Pest and Pathogens Pre-treatment risk ranking .....	76
Table 6-25 Controls to reduce risk and impacts of Introduced pests and pathogens.....	76
Table 6-26 Introduced Pest and Pathogens Residual Risk Ranking.....	78
Table 6-27 Fire Receptor risks and impacts.....	79
Table 6-28 Fire Pre-treatment risk ranking .....	80
Table 6-29 Controls to reduce risk and impacts of fire.....	81
Table 6-30 Fire Residual Risk Ranking .....	82
Table 6-31 Disturbance to stakeholders Receptor risks and impacts .....	83
Table 6-32 Disturbance to Stakeholders Pre-treatment risk ranking.....	83
Table 6-33 Controls to reduce risk and impacts of Disturbance to stakeholders .....	84
Table 6-34 Disturbance to Stakeholders Residual Risk Ranking .....	85
Table 6-35 Waste and chemical spills and leaks Receptor risks and impacts.....	86
Table 6-36 Waste and chemical spills and leaks Pre-treatment risk ranking.....	87
Table 6-37 Controls to reduce risk and impacts of waste and chemical spills and leaks .....	88

Table 6-38 Waste and chemical spills and leaks Residual Risk Ranking .....	89
Table 7-1 Environmental Outcomes, Environmental Performance Standards and Measurement Criteria .....	92
Table 8-1 Key Personnel Roles and Environmental Responsibilities .....	103
Table 8-2 Incident Reporting Requirements .....	106

## Figures

Figure 1-1 Santos' Acreage in the Northern Territory .....	2
Figure 1-2: Santos Environment, Health and Safety Policy .....	3
Figure 3-1 Location of project area .....	16
Figure 3-2 Proposed project footprint .....	17
Figure 3-3 Tanumbirini North lease pad .....	19
Figure 3-4 Indicative water bore lease pad layout.....	19
Figure 4-1 Geology in the vicinity of the Tanumbirini well.....	25
Figure 4-2 Land systems within the project area.....	27
Figure 4-3 Watercourses within the project area.....	29
Figure 4-4 Groundwater bores within the project area.....	31
Figure 4-5 Bioregions within the project area .....	33
Figure 4-6 Vegetation types within the project area .....	35
Figure 4-7 Protected and Conservation Areas .....	41
Figure 5-1 Impact and Risk 'Uncertainty' Decision Making Framework .....	45
Figure 5-2 Santos Residual Risk Acceptance Model .....	50
Figure 8-1 Santos Management System Framework.....	102

## Units of Measurement

Unit	Measurement
°C	Degrees centigrade
ha	Hectare
km	Kilometre (1,000 metres)
km <sup>2</sup>	Square kilometres
L	Litre (1,000 ml)
m	Metre (100 cm)
m <sup>2</sup>	Square metre
m <sup>3</sup>	Cubic metre
mg/L	Milligrams per litre
ML	Megalitre
t	Tonne (1,000 kg)

## Abbreviations and Acronyms

Acronym	Description
AAPA	Aboriginal Areas Protection Authority
ALARP	As Low As Reasonably Practicable
APPEA	Australian Petroleum Production and Exploration Association
BoM	Bureau of Meteorology
DOEE	Australian Department of the Environment and Energy
DPIR	Department of Primary Industry and Resources
EHS	Environment, Health and Safety
EMS	Environmental Management System
EMP	Environment Management Plan
EO	Environmental Outcome
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPS	Environmental Performance Standard
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Environmentally Sustainable Development
GIS	Geographical Information System
IMS	Incident Management System
LACA	Land Access Compensation Agreement
MC	Measurement Criteria
MNES	Matter of National Environment Significance
MoC	Management of Change
NLC	Northern Land Council
NT	Northern Territory
SMS	Santos Management System
SSCC	Sacred Site Clearance Certificate
TEC	Threatened Ecological Communities
TPWC Act	Territory Parks and Wildlife Conservation Act 2014



## Executive Summary

The point of the executive summary is to provide the general public with a summary of the activity project. It allows the public to familiarise themselves with the key aspects of the activity and the approved environmental management requirements.

### Introduction and Scope

Santos QNT Pty Ltd (Santos) is the operator of exploration permit (EP) 161 which is located approximately 350 km south-east of Katherine in the Northern Territory (NT).

Under the Petroleum (Environment) Regulations (the Regulations), interest holders in petroleum titles must prepare and submit an Environment Management Plan (EMP).

Santos has prepared and submitted this Environmental Management Plan (EMP) to facilitate the installation of groundwater monitoring bores at one location within EP 161. The monitoring bores are required to monitor key water quality indicators in the groundwater and collect baseline water quality data.

### Activity Location and Timing

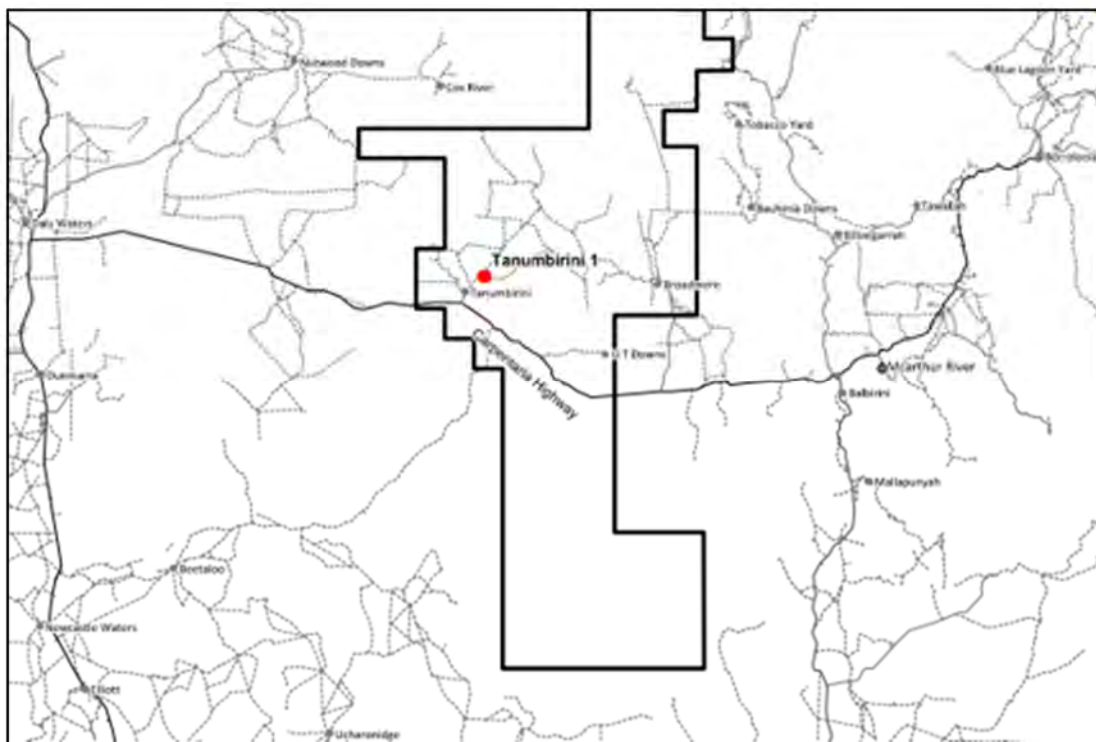
Santos has previously undertaken exploration activities in EP-161, including acquiring 2D seismic, drilling of two wells (Tanumbirini 1 and Marmbulligan 1) and maintenance activities over the last four years.

The Tanumbirini 1 Well was drilled in 2014 and left in a secured condition, cased and suspended. Inspection and maintenance activities have been taking place at the wellhead while the well is suspended.

Santos plans to install groundwater monitoring bores in November 2018. The monitoring bores are required to monitor key groundwater quality indicators and collect baseline water quality data. The location of the lease pad centre point for the well lease pad location is shown in the Table ES-1 and Figure ES-1 below.

**Table ES-1 Water Bore Name and location**

Water Bore	Latitude	Longitude
Tanumbirini North	-16.398769°	134.703242°



**Figure ES-1 Location of Water Bore Lease Pads**

## Description of the Receiving Environment

Tanumbirini Station is located in the Top End of the NT and experiences two distinct seasons: a wet season (October to April) and dry season (May to September). The mean annual rainfall for McArthur River Mine (MRM) Airport (Station 014704), located approximately 100 kilometres (km) west of the project area Airport is 760 mm (based on record averages between 1968 and 2018) (BOM 2018). A majority of rainfall is recorded December to January. The mean maximum temperature ranges between 30 – 35 (°C) in the dry season and between 35 to 38 (°C) in the wet season. The mean minimum temperature ranges between 12 - 17 (°C) in the dry season and between 20 – 25 (°C) in the wet season.

The McArthur Basin covers approximately 180,000 km<sup>2</sup> and comprises a mixed carbonate-siliclastic succession with minor volcanic units near the base. Rock types include quartzose sandstone, mudstone, dolostone and minor mafic and felsic volcanic rocks. Depositional environments range from fluvial and lacustrine to shallow marginal marine in an overall intracratonic setting. Overall the region to the west is flat to gently undulating with little local relief, while the region to the east towards the gulf coast includes dissected sandstone plateaux.

The environmental values and/or sensitivities with the potential to occur in the vicinity of the project are provided in Table ES 2.

**Table ES-2 Summary of Key Receptors**

Environment Receptor	Summary
Groundwater	The Beetaloo Basin is overlain by the Georgina Basin, a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional

Environment Receptor	Summary
	significance. The CLA is a regional scale aquifer that provides groundwater resources for pastoral enterprises, domestic bores at homesteads and town water supplies at a number of small communities across the region. The CLA will be the target of the baseline environmental water monitoring required by this EMP.
Surface water	No rivers are present in the immediate project area. The proposed Tanumbirini North bore is located in the vicinity of an unnamed second order tributary of Tanumbirini Creek. Two sacred sites associated with waterholes are located in the vicinity of the project area.
Native fauna	There are six birds, four mammals and one reptile listed as threatened under the EPBC Act that are modelled as likely or known to occur or within 10 km of the project area. In addition, one reptile and one mammal listed under the TPWC Act has been recorded within 10 km of the project area. Threatened species have the potential to be found in the project area.
Native flora / habitat	The project area is covered by the Gulf Falls and Uplands Bioregion. No Threatened Ecological Communities (TECs) or threatened flora listed under the EPBC Act and/or TPWC Act are known to occur within 10 km of the project area.
Environmentally sensitive sites	Bullwaddy Conservation Reserve is located approximately 40 km west of the project area and south of the vehicle access track. Bullwaddy Conservation Reserve represents the only declared conservation area within the Sturt Plateau region of the lancewood/bullwaddy vegetation type.
Culturally sensitive sites	AAPA sacred sites are recorded within 3 km of the project area. Conditions of AAPA Authority Certificate C2014/053 specify restricted works areas associated with those sacred sites. NLC sacred site avoidance survey identifies two NLC recorded sacred sites north of the project area. No sacred sites are known to occur within the project area.
Landholders	The project is located on the Tanumbirini property. The Tanumbirini Homestead, located approximately 8.5 km southwest of the proposed water bore.

## Description of the Activity

Santos has prepared and submitted this Environmental Management Plan (EMP) to facilitate the installation of groundwater monitoring bores to meet the recommendations and commentary from the Final Report. The monitoring bores are required to monitor key water quality indicators in the groundwater and collect baseline water quality data. Activities include scouting of water bore locations and access tracks for the nominated locations, preparation of water bore lease pads and installation of the water bores. Existing landholder tracks have been used to provide access. Importantly, no vegetation clearing is required and no road upgrades are required.

All water bores will be constructed in accordance with the established guidelines that are in place for installation of water bores (refer <https://nt.gov.au/environment/water/bores-drilling-and-dams>). Water bore drilling activities will include installation of up to two (2) water bores, at one

location. Water bores will notionally be 120-200m deep x 155mm diameter casing with a pump installed to supply 4 Lt/s, using a suitably licenced water bore driller as per the NT Water Act.

Ongoing baseline environmental monitoring and aquifer testing may be conducted, including abstraction of ground water from existing (if available) and new water bores.

## **Major Environmental Risks/Impacts and Controls**

The planned and potential interactions between the activity, the aspects triggered and the environment represent a source of risk (or impact) which has potential to affect the environment. Planned / routine aspects include: physical disturbance, atmospheric emissions noise. Unplanned / non-routine aspects include: fauna interaction, erosion, introduction of pests and pathogens, fire, disturbance to stakeholders, waste and chemical leaks.

For each aspect, receptors were identified and the risk or impact was assessed based on the likelihood of occurrence and the severity of potential consequences, and a pre-treatment risk ranking was identified to assist with the determination of the level of controls required to reduce the risk or impact. Control measures were identified in accordance with defined environmental performance outcomes, to eliminate, prevent, reduce or mitigate consequences associated with each of the identified environmental risks or impacts. A final residual risk ranking was undertaken to determine impact and risk acceptability and demonstrate the impact and risks have been reduced to as low as reasonable practicable (ALARP).

## **Management Approach**

Santos is committed to ensuring that its activities are undertaken in a manner that is environmentally responsible through setting Environmental Outcomes (EO) and Environmental Performance Standards (EPS). This EMP includes EOs that address the risks that are identified. For each EO, there is at least one related EPS, that either reduces the likelihood of the risk or impact occurring, or reducing the impact or consequence of the risk.

## **Environmental outcomes in relation to the activity**

Through implementation of control measures, the residual risk ranking for most risks or impacts have been reduced to 2 (risk is acceptable provided ALARP has been achieved and demonstrated) or 1 (risk is acceptable and it is assumed that ALARP has been achieved).

Control measures have been identified using the Santos hierarchy of controls; a process which moves from risk elimination through to protection, in descending order of effectiveness, until a control measure(s) can be identified.

## **Implementation Strategy**

Santos manages the environmental impacts and risks of its activities through the implementation of the Santos Management System (SMS). The SMS provides a formal and consistent framework for all activities of Santos employees and contractors. The SMS includes Code of Conduct and Policies, Management Standards Processes, Procedures and Tools.

## **Stakeholder consultation**

Santos is committed to upholding its long-held reputation as a trusted Australian energy company. Santos seeks to establish and maintain enduring and mutually beneficial relationships with the communities of which it is a part; ensuring that Santos' activities generate positive economic and social benefits for and in partnership with these communities. In preparation for the 2018 / 2019 program of works, relevant stakeholders were identified and engaged such that

they could be informed of the proposed activities, and have their specific issues considered and addressed. Stakeholders include:

- Community
- Landholders
- Traditional Owners and Aboriginal Peoples
- Representatives of Local Government
- Northern Territory Government departments

During both the planning and operational phase of the project, Santos will have a field based member of the Land Access team in the region. They will be the primary point of contact for all landholders and community members during these phases. During the operational phase of the project the Santos Field Representative will also manage day to day activities and communications with respect to the landholders to ensure they are consistently updated on the status of the project.

### Contact details of the interest holder’s nominated liaison personnel

Table ES-3 provides details of the permit titleholder and titleholder nominated liaison person.

**Table ES-3 Details of Titleholder and Nominated Liaison Person**

Titleholder Details	Liaison Person Details
Name: Santos QNT Pty Ltd 60 Flinders Street, Adelaide, SA 5000 Telephone number: 08 8116 5000 ACN: 083 077 196	Name: David Close Position: Exploration Manager – Onshore NT, QLD & NSW Company: Santos Ltd Address: 60 Flinders Street, Adelaide, SA 5000 Phone : 08 8116 7897 Email: David.Close@santos.com

## 1.0 INTRODUCTION

### 1.1 Scope of this Environmental Management Plan

Santos QNT Pty Ltd (Santos) is the operator of exploration permit (EP) 161 which is located approximately 350 km south-east of Katherine in the Northern Territory (NT) (Figure 1-1). Santos has previously undertaken exploration activities in EP-161, including acquiring 2D seismic, drilling of two wells Tanumbirini 1 and Marmbulligan 1 and maintenance activities over the last four years.

Under the Petroleum (Environment) Regulations (the Regulations), interest holders in petroleum titles must prepare and submit an Environment Management Plan (EMP). Approval of an EMP is necessary for all activities that have an environmental impact or risk and is only one of several approvals required for the activity to proceed. An approved EMP is a statutory document that is enforceable through the Northern Territory (NT) legislation.

Santos has prepared and submitted this Environmental Management Plan (EMP) to facilitate the installation of a groundwater monitoring bores. The monitoring bores are required to monitor key groundwater quality indicators and collect baseline water quality data.

### 1.2 Titleholder details

Table 1-1 provides details of the permit titleholder and titleholder nominated liaison person.

If there is a change in the titleholder, the titleholder's nominated liaison person or a change in the contact details for the titleholder or liaison person, Santos will notify the Department of Primary Industry and Resources (DPIR) and provide the updated details.

**Table 1-1 Details of Titleholder and Nominated Liaison Person**

Titleholder Details	Liaison Person Details
Name: Santos QNT Pty Ltd	Name: David Close
Address: 60 Flinders Street, Adelaide, SA 5000	Position: Exploration Manager – Onshore NT, QLD & NSW
Phone: 08 8116 5000	Company: Santos Ltd
ACN: 083 077 196	Address: 60 Flinders Street, Adelaide, SA 5000
	Phone : 08 8116 7897
	Email: David.Close@santos.com



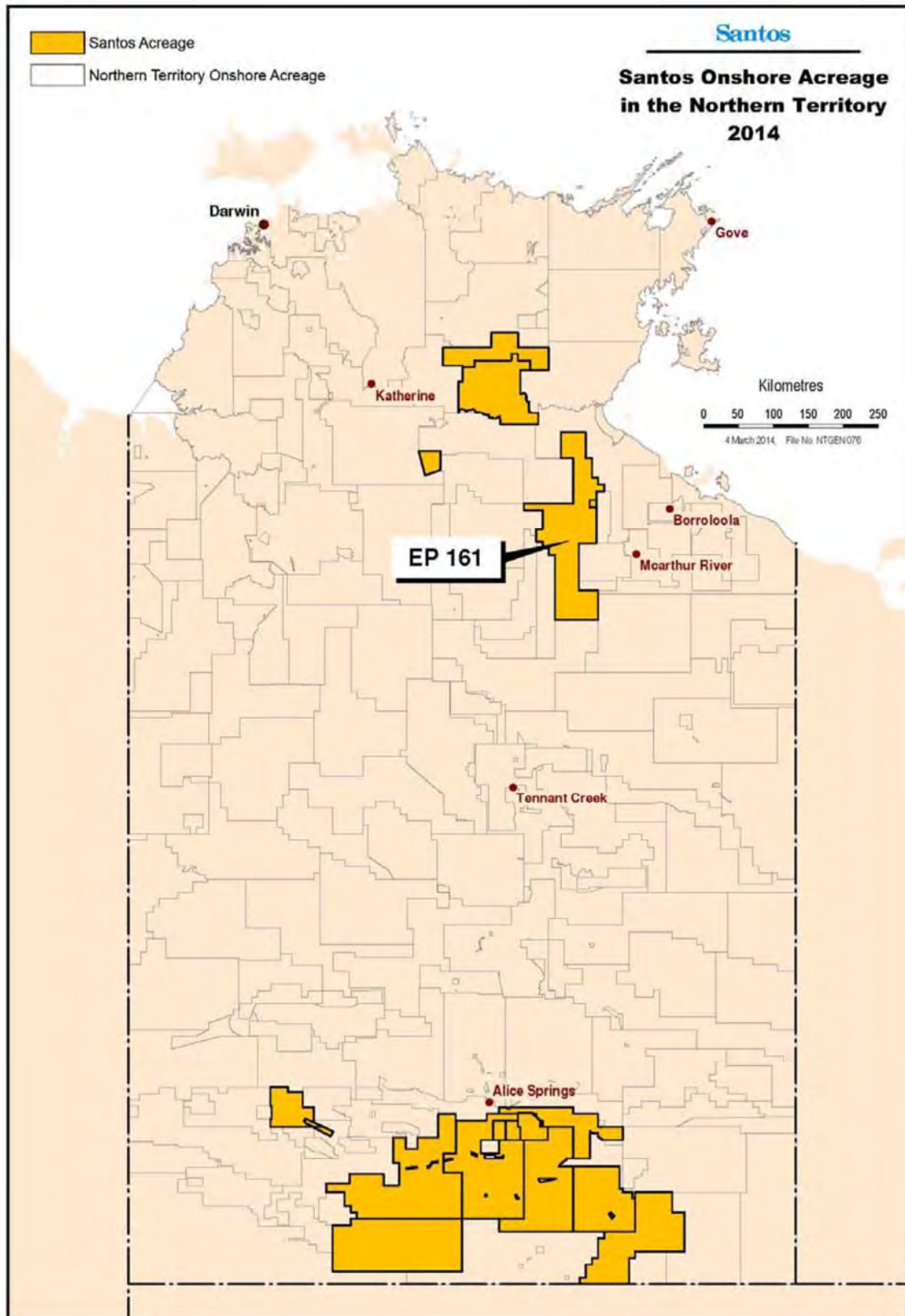



Figure 1-1 Santos' Acreage in the Northern Territory

### 1.3 Corporate environment policy

The Santos Corporate Environmental Policy is provided in Figure 1-2. The policy is Santos’ public declaration to understanding and managing the environmental impacts and risks associated with its operations and complying with all relevant environmental, health and safety laws.

The Santos Environmental Policy was endorsed by the Managing Director and Chief Executive Officer and approved by the Board. All personnel are responsible for the environmental performance of their activities and for complying with the general environmental duty as outlined in the Santos Environment, Health and Safety Policy.

## Environment, Health and Safety Policy




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### Our Commitment

Santos is committed to a workplace where we all go home without injury or illness and manage the impact of our operations on the environment.

### Our Actions

We will:

1. implement a structured and systematic approach to environmental, health and safety management and monitor its effectiveness
2. include environmental, health and safety considerations in business planning and decision-making processes
3. understand and manage the impact of our operations on the environment
4. comply with all relevant environmental, health and safety laws
5. promote a strong and consistent safety culture across all aspects of business
6. work pro-actively and collaboratively with our stakeholders and the communities in which we operate
7. set, measure and review objectives and targets which drive continuous improvement
8. report publicly on our environmental, health and safety performance

### Governance

The Environment Health Safety & Sustainability Committee is responsible for reviewing the effectiveness of this policy.

This Policy will be reviewed at appropriate intervals and revised when necessary to keep it current.

Kevin Gallagher  
Managing Director & CEO

Status: APPROVED

Document Owner:	Naomi James, Executive Vice President, EHS & Governance		
Approved by:	The Board	Version:	1

APPROVED 28 October 2016 Page 1 of 1

Figure 1-2: Santos Environment, Health and Safety Policy



## 2.0 ENVIRONMENT LEGISLATION AND OTHER REQUIREMENTS

The *Petroleum Act 2016* (NT) is the governing legislation for onshore petroleum activities in the NT and the Petroleum (Environment) Regulations (the Regulations) govern environmental management. The objectives of the Regulations are to ensure that:

- Onshore oil and gas activities are carried out in a manner consistent with the principles of ecologically sustainable development (ESD); and
- Environmental impacts and risks associated with onshore oil and gas activities are reduced to a level that is as low as reasonably practicable (ALARP) and acceptable.

The Regulations achieve these objectives by requiring interest holders to have an approved EMP in place before a 'regulated activity' can be undertaken. An EMP will be approved when the Minister for Primary Industry and Resources (the Minister) is satisfied that approval criteria have been met.

The approval criteria for an environment management plan are provided in Section 9 of the Petroleum (Environment) Regulations:

### **9 Approval criteria for plan**

- (1) *The approval criteria for an environment management plan are that the plan must:*
  - (a) *include all the information required by Schedule 1; and*
  - (b) *be appropriate for the nature and scale of the regulated activity to which the plan relates; and*
  - (c) *demonstrate that the activity will be carried out in a manner by which the environmental impacts and environmental risks of the activity will be reduced to a level that is:*
    - (i) *as low as reasonably practicable; and*
    - (ii) *acceptable.*
- (2) *When considering whether an environment management plan meets the approval criterion mentioned in subregulation (1)(c), the Minister must take into account:*
  - (a) *the principles of ecologically sustainable development; and*
  - (b) *if an environmental report or statement has been prepared, or is required to be prepared, in relation to the regulated activity to which the plan relates – each environmental assessment recommendation in the assessment report made about the activity.*
- (3) *In this regulation:*  
*environmental report or statement means a public environmental report or environmental impact statement mentioned in section 7(2) of the Environmental Assessment Act.*

There are other legislation, agreements and codes of practice relevant to the project, which are detailed in sections 2.1- 2.4.

## 2.1 Key Legislation Overview

**Table 2-1: Key relevant Commonwealth and Northern Territory legislation**

Act	Summary
Commonwealth	
<i>Aboriginal Land Rights (Northern Territory) Act 2013</i>	<p>This Act is the key mechanism for the creation of Aboriginal-owned freehold land in the NT. It also includes provisions for the establishment of Land Trusts (over which the Land Councils have oversight).</p> <p>Land Councils may issue Sacred Sites Clearance Certificates under the Act.</p>
<i>Australian Heritage Council Act 2003</i>	<p>Establishes the Australian Heritage Council that is the principal adviser to the Australian Government on heritage matters. The Council's main role is to assess the heritage values of places nominated for the National Heritage List and the Commonwealth Heritage List, and to advise the Minister on promotion, research, education, policies, grants, conservation and other matters.</p>
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>	<p>Provides for the protection of the environment and the conservation of biodiversity. It regulates a development or activity if it is likely to have a significant environmental impact on matters of national environmental significance (MNES).</p> <p>Under the EPBC Act, any petroleum activity that has, or will have, the potential to have a significant impact on a matter of national environmental significance (MNES) must be referred to the DoE for assessment. This includes any activity covered by the following nine (9) controlling provisions:</p> <ul style="list-style-type: none"> <li>• world heritage properties;</li> <li>• national heritage places;</li> <li>• wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);</li> <li>• nationally threatened species and ecological communities;</li> <li>• migratory species;</li> <li>• Commonwealth marine areas;</li> <li>• the Great Barrier Reef Marine Park;</li> <li>• nuclear actions (including uranium mining);</li> <li>• a water resource, in relation to coal seam gas development and large coal mining development.</li> </ul> <p>This Act is administered by the Commonwealth Department of the Environment and Energy (DoEE). It is considered that the proposed activities will not adversely impact MNES. Therefore, the project has not been referred for assessment and approval under the EPBC Act.</p>
<i>National Environment Protection Council Act 1994</i>	<p>Provides national standards for ambient air quality, movement of controlled wastes, and contaminated sites. This Act is administered by DoEE.</p>
<i>National Greenhouse and Energy Reporting Act 2007</i>	<p>Titleholders are required to report emissions and energy use annually in accordance with this Act.</p>
<i>Native Title Act 1993</i>	<p>This Act provides statutory recognition and protection for the concept of native title, including provisions for reaching Indigenous land use agreements.</p>

Act	Summary
Northern Territory	
<i>Aboriginal Land Act 2013</i>	This Act regulates access to Aboriginal land, certain roads bordered by Aboriginal land and the seas adjacent to Aboriginal land and provides for permits to enter onto or remain on Aboriginal land or use a road.
<i>Aboriginal and Torres Straights Heritage Protection Act 1984</i>	Protects areas and objects in Australia that are of particular significance to Aboriginals in accordance with Aboriginal tradition. The Act allows the Commonwealth Environment Minister, on the application of an Aboriginal person or group of persons, to make a declaration to protect an area, object or class of objects from a threat of injury or desecration.
<i>Biological Control Act 2011</i>	Makes provision for the biological control of pests in the NT, and related purposes.
<i>Bushfires Management Act 2016</i>	Provides for the protection of life, property and the environment through the mitigation, management and suppression of bushfires, and for related purposes.
<i>Control of Roads Act 2015</i>	Provides for the administration and control of public or gazetted roads, including the maintenance of roads and opening and closing of roads.
<i>Dangerous Goods (Road and Rail Transport) Act 2012</i>	Makes provision for safety in the transport of dangerous goods by road as part of the system of nationally consistent road transport laws and makes provision for safety in the transport of dangerous goods by rail. Establishes common guidelines so that dangerous goods can be transported between states and territories.
<i>Energy Pipelines Act 2015</i>	Makes provision for the construction, operation, maintenance and cessation of use or abandonment of pipelines for the conveyance of energy-producing hydrocarbons.
<i>Environmental Assessment Act 2013</i>	<p>Establishes the framework for the assessment of potential or anticipated environmental impacts of developments, and provides for protection of the environment. The NT Environment Protection Authority (NT EPA) is responsible for administering the Act.</p> <p>The NT EPA also determines the appropriate level of assessment for new developments or material changes to existing operations, based on the sensitivity of the local environment, the scale of the proposal and its potential impact upon the environment.</p> <p>Petroleum developments that may have a significant environmental impact must be assessed under the Act. It is considered that the proposed activities will not have a significant impact and therefore, the project will not be referred for assessment and approval under the Act.</p>
<i>Environmental Offences and Penalties Act 2011</i>	Establishes a penalty structure for environmental offences based around four offence levels. Penalties are defined in a variety of environmental statutes such as the Waste Management and Pollution Control Act and the Water Act.
<i>Fire and Emergency Act 2016</i>	Provides provisions for the establishment of Northern Territory Fire and Rescue Service and emergency response groups and their role in dealing with fires and other emergencies. The Act also provides for restrictions on lighting fires and the responsibilities of occupiers of land in relation to fires.

Act	Summary
<i>Heritage Act 2011</i>	Establishes the Heritage Council and the NT Heritage Register. It sets the process by which places become heritage places, allows for interim protection of places and sets out the process for getting permission to do work to heritage places and allows for fines and imprisonment for offences against the Act.
<i>Northern Territory Aboriginal Sacred Sites Act 2013</i>	Establishes the Aboriginal Areas Protection Authority (AAPA) as the body responsible for overseeing the protection of sacred sites in the NT. The AAPA provides a process for avoidance of sacred sites and/or entry onto sacred sites, and the issue of Authority Certificates which indemnify the holder against prosecution under the Act for damage to sacred sites in the certificate area, provided works or use has occurred in accordance with the conditions of the Authority Certificate.
<i>NT Petroleum (Environmental) Regulations 2016</i>	The objectives of the Regulations are to ensure that onshore oil and gas activities are carried out in a manner consistent with the principles of ecologically sustainable development (ESD) and environmental impacts and risks associated with onshore oil and gas activities are reduced to a level that is as low as reasonably practicable (ALARP) and acceptable.
<i>Petroleum Act 2016</i>	<p>The Petroleum Act is the principal legislation dealing with petroleum tenure, exploration and production activities onshore and in inland waters of the NT. The Act provides a legal framework to undertake exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the NT.</p> <p>The Act is supported by the Petroleum Regulations (Regulations) and the Schedule of Onshore Petroleum Exploration and Production Requirements 2012 (Schedule). The Regulations aim to ensure that:</p> <p>a) onshore oil and gas activities are carried out in a manner consistent with the principles of ecologically sustainable development (ESD); and</p> <p>b) environmental impacts and risks associated with onshore oil and gas activities are reduced to a level that is as low as reasonably practicable (ALARP) and acceptable.</p> <p>The Regulations achieve these objectives by requiring interest holders to have an approved EMP in place before a 'regulated activity' can be undertaken.</p> <p>The rules governing access by an interest holder to Pastoral Leases (granted under the Pastoral Land Act 1992) are set out in the Petroleum Act Stakeholder Engagement Guidelines Land Access (Land Access Guidelines). The Act, Regulations and Requirements are administered by the Northern Territory Petroleum Registry (Registry) which forms part of the DPIR. The Minister for Primary Industry and Resources (Minister) is the applicable Minister for the purposes of the Act.</p>
<i>Petroleum (Prospecting &amp; Mining) Regulations 2001</i>	Provides that annual rent prescribed by the Petroleum Act is increase to cover GST in respect of a period after 30 June 2000.
<i>Planning Act 2017</i>	Provides for appropriate and orderly planning and control of the use and development of land. The Act establishes the NT Planning Scheme and provides for a development approval process, provides for interim development control, provides for an appeals regime and enforcement and establishes the Development Consent Authority.
<i>Plant Health Act 2015</i>	The objects of this Act are to ensure appropriate actions can be taken for the control of pests and to facilitate the production and trading of plants and plant products that are free from pests.

Act	Summary
<i>Public and Environmental Health Act 2016</i>	<p>Makes provision to protect and promote the health of individuals and communities in the Territory, and to monitor, assess and control environmental conditions, factors and factors and agents, facilities and equipment and activities, services and products that impact on or may impact on public and environmental health.</p> <p>Other relevant regulations under the Act include Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations.</p> <p>Wastewater treatment systems are be subject to requirements of the Act. Sewerage plants need to meet the NT Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent.</p>
<i>Public and Environmental Health Act 2015 and Regulations</i>	<p>The objects of this Act include to protect and promote the health of individuals and communities in the Territory and to improve the public and environmental health outcomes of all Territorians in partnership with individuals and the community. The Act provides requirements for sewerage systems and wastewater treatment systems to be approved.</p>
<i>Schedule of Onshore Petroleum Exploration &amp; Production Requirements 2017 (under the Petroleum Act 2016)</i>	<p>Petroleum titleholders are directed to comply with the Schedule of Onshore Petroleum Exploration and Production Requirements 2017 ("Schedule") under Sections 71 and 72 of the Petroleum Act.</p> <p>The Schedule provides general requirements for safety and systems integrity, drilling, well re-entry and workover operations, production operations, geophysical and geological surveys and the reporting requirements for petroleum interests</p>
<i>Soil Conservation and Land Utilisation Act 2013</i>	<p>Makes provisions for the prevention of soil erosion and soil conservation and reclamation. It makes provisions for restricting construction activities that may damage or further damage land that is not environmentally stable, such as areas suffering soil erosion or areas that have the potential to erode.</p>
<i>Territory Parks and Wildlife Conservation Act 2014 (TPWC Act)</i>	<p>Makes provision for the establishment of Territory Parks and other Parks and Reserves and the study, protection, conservation and sustainable utilisation of wildlife. It sets aside areas of the NT as parks and conservation areas that may not be developed. Flora and fauna can also be declared as threatened species under the Act.</p>
<i>Waste Management and Pollution Control Act 2016</i>	<p>Aims to protect, and where practicable, restore and enhance the quality of the NT environment; encourage ecologically sustainable development; and facilitate the implementation of National Environmental Performance Measures established by the National Environment Protection Council. It is designed to prevent contamination of the surrounding environment, including soil, air, and water, and imposes a general duty on conducting an activity or action that causes or is likely to cause pollution resulting in environmental harm, or that generates or is likely to generate waste.</p> <p>The disposal of listed waste and discharge of water to the environment requires a licence under the Act.</p> <p>The WMPC Act does not apply within the petroleum permit area.</p>
<i>Water Act 2013</i>	<p>Provides for the investigation, allocation, control, protection, management and administration of water resources in the NT. The Act prohibits waste to come in contact with water or water to be polluted unless under authorisation.</p> <p>The Water Act currently exempts gas companies from the need to get a water extraction licence under the Water Act, but is currently undergoing reform, and a water extraction licence may be required in the future.</p>

Act	Summary
<p><i>Weeds Management Act 2013</i></p>	<p>Aims to prevent the spread of weeds throughout the NT, ensuring the management of weeds is an integral component of land management. It is designed to ensure there is community consultation in the creation of weed management plans and that the landholder or interest holder takes responsibility in implementing weed management plans.</p> <p>If a weed is declared, all land holders, land managers and land users must comply with the declaration classification.</p> <p>The following are the three classes of declared weeds in the NT:</p> <ul style="list-style-type: none"> <li>• Class A - to be eradicated</li> <li>• Class B - growth and spread to be controlled</li> <li>• Class C - not to be introduced into the NT.</li> </ul> <p>All Class A and Class B weeds are also Class C weeds.</p>
<p><i>Work Health and Safety (National Uniform Legislation) Act 2016</i></p>	<p>The WHS Act is part of the nationally harmonised work health and safety laws, which aim to provide all workers in Australia with the same standard of health and safety protection regardless of the work they do or where they work.</p>
<p>International Agreements</p>	
<p>Migratory species:</p> <p>Japan-Australia Migratory Bird Agreement</p> <p>China-Australia Migratory Bird Agreement</p> <p>Republic of Korea-Australia Migratory Bird Agreement</p> <p>Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)</p>	<p>Australia is party to many international agreements to protect and conserve migratory species and their habitat. Migratory species listed on the annexes to these Agreements are placed on the migratory species list under the EPBC Act.</p>
<p>Ramsar Convention on Wetlands</p>	<p>The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain.</p> <p>Ramsar wetlands within Australia are listed as a Matter of Environmental Significance and protected under the EPBC Act.</p>

## 2.2 Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory

The Northern Territory Government accepted all 135 recommendations in the Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (Final Report). Table 16.1 of the Final Report details the recommendations that need to be implemented before any drilling and hydraulic fracturing can occur on Exploration Permits. Santos wishes to undertake pre-exploration activities (enabling activities) in 2018 to allow the 2019 program of works to proceed in accordance with these recommendations. The establishment of the proposed baseline water

monitoring bores proposed in this management plan are in line with the baseline data collection recommendations and commentary from the Final Report, specifically:

*'The Panel's view is that monitoring of key water quality indicators in the groundwater in close proximity (that is within 10-20 m) to each planned well or well pad is essential, and that this monitoring should commence prior to any well drilling, with subsequent monitoring being particularly focussed on the hydraulic fracturing stages. To this end, multi-level monitoring bores must be installed in advance (at least six months)'.*<sup>1</sup>

This management plan seeks to install monitoring bores that will monitor key water quality indicators in the groundwater in advance of any exploration well drilling.

### **2.3 Relevant Agreements and Operating Consents**

Land access guidelines under the Petroleum Act require Santos to reach agreement with the Pastoralist prior to the commencement of exploration activities.

The Regulations sets out a process for stakeholder engagement when a company proposes to undertake a regulated activity. Stakeholder engagement undertaken for the project is discussed in Section 9.0.

Traditional owners under the Native Title Act, and Aboriginal owners under the Land Rights Act are given the opportunity to negotiate an agreement about how petroleum activities must occur in accordance with statutory processes described in each Act.

The agreement, Co-operation and Exploration Agreement - Exploration Permit Application EP (A) 161, Northern Territory, executed on 4 April 2012, is a legal agreement between Tamboran Resources Pty Ltd and the Northern Land Council (NLC) (the body corporate representing the Traditional Owners). The agreement is referred to by Santos as 'the NLC EP 161 Agreement'.

Santos will ensure that prior to commencement of the new works proposed in this EMP, that necessary consents and approvals have been identified, obtained and are in place and the work will be undertaken in accordance with the terms and conditions as detailed in the NLC Agreement.

### **2.4 Codes of Practice and Relevant Guidelines**

Contractors undertaking activities will be required to comply with the following environmental standards, guidelines and codes of practice:

- Santos Management System (SMS).

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<sup>1</sup> Scientific Inquiry Into Hydraulic Fracturing In The Northern Territory - Final Report, April 2018 p. 150



- Australian Petroleum Production and Exploration Association (APPEA) *Code of Environmental Practice* (2008).
- Northern Territory Government Petroleum (Environment) Regulations: Explanatory Guide (1 December 2017).

## **2.5 Further referral of the project**

### **2.5.1 Referral under the Environmental Protection and Biodiversity Conservation Act 1999**

The *Environmental Protection and Biodiversity Conservation Act 1999* provides for the protection of the environment and conservation of biodiversity, particularly matters of national environmental significance. Referral of the project to the Department of Environment and Energy is required if the proposed action will have, or is likely to have a significant impact. It is considered that the proposed activities will not adversely impact MNES. Therefore, the project has not been referred for assessment and approval under the EPBC Act.

### **2.5.2 Referral under the Environmental Assessment Act (EA Act)**

Petroleum activities that could reasonably be considered to be capable of having a significant effect on the environment are referred to the NT Environment Protection Authority (NTEPA), pursuant to Section 7 of the Environmental Assessment Act (EA Act). Using the NTEPA guideline REFERRING A PROPOSAL TO THE NTEPA: A guide for proponents and referral agencies, a detailed review of and assessment against each prescribed environmental objectives for each environmental factor was conducted in relation to the installation of the groundwater monitoring bores (the proposed activity) and shown in Table 2-2 below. It is evident from this review that referral to the NTEPA is not required as the installation of the groundwater monitoring bores do not have the potential to have a significant effect on an environmental factor.



**Table 2-2: NTEPA Environmental Factors and Objectives Assessment**

Environmental Factor	Significant Effect	Environmental Objective	Relevance to the Application
<b>LAND</b>			
Factor 1. Terrestrial Flora and Fauna	X	Protect NT's flora and fauna so that biological diversity and ecological integrity are maintained.	As described throughout Section 6, the proposed activities are likely to result in only minor localised impacts to non-sensitive vegetation, and have the potential to result in only occasional localised impacts to native fauna through planned physical disturbance, atmospheric emissions and noise; and unplanned fauna interactions, erosion, introduced pests/pathogens, fire, and waste and chemical spills and leaks. The control measures outlined in Section 6, particularly those within Table 6-4, 6-17 and 6-25, will be employed to ensure that these risks and impacts are managed and further mitigated. Accordingly, biological diversity and ecological integrity will be maintained and there would be no potential for a significant effect to terrestrial flora and fauna as a result of the proposed activities.
Factor 2. Terrestrial Environmental Quality	X	Maintain the quality of the land and soils so that environmental values are protected.	As described in Section 6.2.1, 6.3.2 and 6.3.6, the proposed activities have the unlikely potential to result in localised medium term disturbance to land and soil resources through planned physical disturbance; and unplanned erosion, and waste and chemical spills and leaks. The control measures outlined in Section 6, Tables 6-4, 6-21 and 6-37, will be employed to ensure that these potential risks and impacts are managed and further mitigated. Given this, and that the area of actual ground disturbance proposed is relatively small, the proposed activities would not comprise the quality of the land and soils. Accordingly, there would be no potential for a significant effect to terrestrial environmental quality.
Factor 3. Landforms	X	Conserve the variety and integrity of distinctive physical landforms so that environmental values are protected.	EP-161 is covered by gorges, water holes and dissected sandstone plateaus (within the Gulf Falls and Uplands Bioregion) and flat to gently undulating plains with little local relief (within the Sturt Plateau Bioregion), as outlined in Section 4.3.1. Given the nature (relatively small scale) and location (primarily in areas of existing disturbance) of the proposed activities, and the implementation of the control measures outlined in Section 6, it is unlikely the distinct physical landforms within these two bioregions will be impacted. Accordingly, there would be no potential for a significant effect on landforms.
<b>WATER</b>			
Factor 1. Aquatic Ecosystems	X	Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.	As discussed in Section 4.3.3, 6.2.1, 6.3.2 and 6.3.6, it is unlikely aquatic ecosystems will be impacted by the proposed activities, given that no sensitive vegetation will be disturbed, the area of disturbance is relatively small scale, and there is a lack of permanent surface waters and terrestrial GDEs in the project area vicinity. Furthermore, the control measures outlined in Section 6, Tables 6-4, 6-21 and 6-37, will be employed to ensure that potential risks and impacts are managed and further mitigated. Accordingly, there would be no potential for a significant effect on aquatic ecosystems.

Environmental Factor	Significant Effect	Environmental Objective	Relevance to the Application
Factor 2. Inland Water Environmental Quality	X	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.	As discussed in Section 6.3.2 and 6.3.6, the proposed activities have the unlikely potential to result in localised and short term disturbance to inland water quality through unplanned erosion and chemical leaks and spills. Given the lack of permanent surface waters and the turbid nature of surface waters during times of flood, in conjunction with the controls outlined in Table 6-37 to mitigate chemical leaks and spills (including limiting the quantity of chemicals brought to site), it is unlikely the inland water quality will be impacted. Accordingly, there would be no potential for a significant effect on inland water environmental quality.
Factor 3. Hydrological Processes	X	Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	As discussed in Section 6.2.1, it is unlikely hydrological regimes of ground waters or surface waters will be altered by the proposed activities, given that the area already has a low level of vegetation coverage (unlikely to change recharge water rates and volumes), the small area of planned disturbance and the lack of permanent surface waters in the project area vicinity. Furthermore, the control measures outlined in Table 6.-4 will be employed to ensure that these potential risks and impacts are managed and further mitigated. Accordingly, there would be no potential for a significant effect on hydrological processes.

**SEA**

Factor 1. Marine Flora and Fauna	X	Protect marine flora and fauna so that biological diversity and ecological integrity are maintained.	The proposed activities are not located within or in proximity to a marine or coastal environment. Accordingly, there will be no potential for a significant effect on marine flora and fauna, benthic communities and habitats, marine environmental quality and coastal processes.
Factor 2. Benthic Communities and Habitats		Protect benthic communities and habitats so that biological and functional diversity and ecological integrity are maintained.	
Factor 3. Marine Environmental Quality		Maintain the quality and productivity of water, sediment and biota so that environmental values are protected.	
Factor 4. Coastal Processes		Maintain the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are protected.	

**AIR**

Environmental Factor	Significant Effect	Environmental Objective	Relevance to the Application
Factor 1. Air Quality and Greenhouse Gases	X	Maintain air quality and minimise emissions and their impact so that environmental values are protected.	As described in Section 6.2.2, the proposed activities have the potential to result in localised, short term minor impacts to air quality through planned atmospheric emissions. The control measures outlined in Section 6, Table 6-8, will be employed to ensure that these potential risks and impacts are managed and further mitigated. Given this, and the relatively small nature of operations, the proposed activities would maintain air quality. Accordingly, there would be no potential for significant effect to air quality and greenhouse gases.

**PEOPLE AND COMMUNITIES**

Factor 1. Social, Economic and Cultural Surroundings	X	Protect the rich social, economic, cultural and heritage values of the Northern Territory.	As described throughout Section 6, the proposed activities have the unlikely potential to result in disturbance to culturally sensitive sites and/landholders through planned physical disturbance, and unplanned stakeholder interactions, erosion and fire. The control measures outlined in Section 6, Tables 6-4, 6-21, 6-29 and 6-33, will be employed to ensure that these potential risk and impacts are managed and mitigated. Furthermore, as the areas proposed to be disturbed have been surveyed for sacred sites and cultural heritage significance and an AAPA certificate is in place. The risk of impacts to any sites of cultural significance has been mitigated. Given this, and the relatively small nature of operations and proposed actual ground disturbance, the proposed activities will maintain the social, economic, cultural and heritage values of the Northern Territory.
Factor 2. Human Health	X	Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.	As described in Section 6.3.6, the proposed activities have the unlikely potential to result in human health impacts if humans consume surface water or groundwater contaminated due to unplanned waste and chemical leaks and spills, or through the construction of the groundwater monitoring bores that create a conduit to the groundwater resource. The control measures outlined in Section 6, Table 6-37 will be employed to ensure that these potential risks and impacts are managed and further mitigated. Accordingly, there would be no potential for significant effect to human health.

## 3.0 DESCRIPTION OF THE ACTIVITY

### 3.1 Activity Overview

Santos has previously undertaken activities within EP 161 including seismic surveys, a core hole program drilling including one wells Tanumbirini 1 and ongoing well maintenance over the last four years.

Santos has prepared and submitted this Environmental Management Plan (EMP) to facilitate the installation of groundwater monitoring bores to meet the recommendations and commentary from the Final Report. The monitoring bores are required to monitor key water quality indicators in the groundwater and collect baseline water quality data. Activities include scouting of water bore locations and access tracks for the nominated locations, preparation of water bore lease pads and installation of the water bores. Existing landholder tracks have been used to provide access. Importantly, no vegetation clearing is required and no road upgrades are required.

The location of the groundwater monitoring lease pad has been preferentially located in an area of existing disturbance (See Figure 3-2).

### 3.2 Location

EP-161 is located in the McArthur Basin in the far north-east of the NT and is centred approximately 350 km south-east of Katherine (Figure 1-1). The water bore location is located on Tanumbirini Station, a 5000 km<sup>2</sup> cattle grazing property, and within NT Cadastral Parcel 701 of Arnold (Figure 3-1).

Centre point coordinates for the proposed water bore site is documented in the table below. The actual location of any individual water bore will be within a 50m radius of the specified centre point location. The location of the centre point is provided in

**Table 3-1 location of lease pad centre point**

Water Bore	Latitude	Longitude
Tanumbirini North	-16.398769°	134.703242°

The maximum estimated project footprint for the water bore Infrastructure is 7,850m<sup>2</sup> (Figure 3-2).

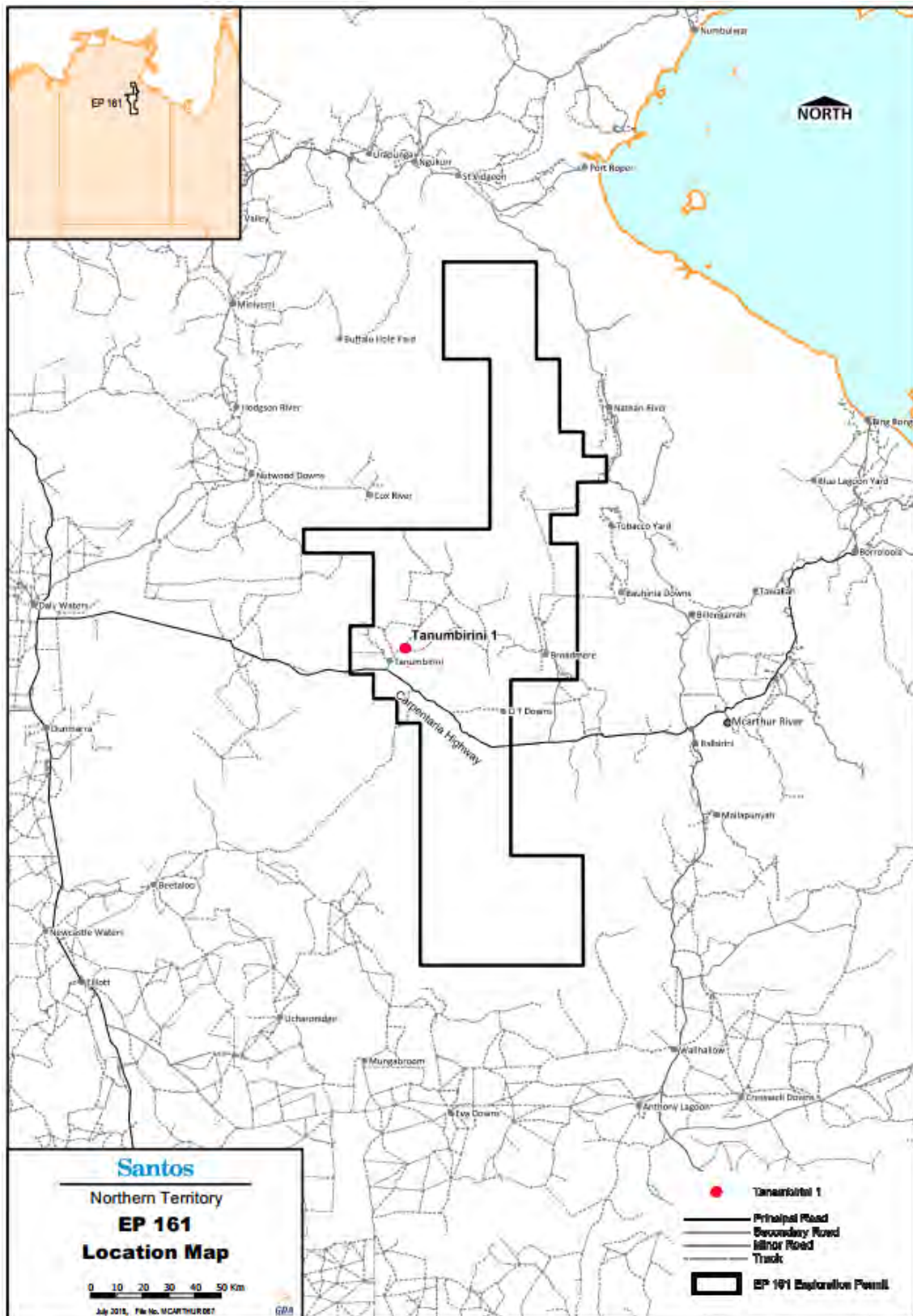


Figure 3-1 Location of project area



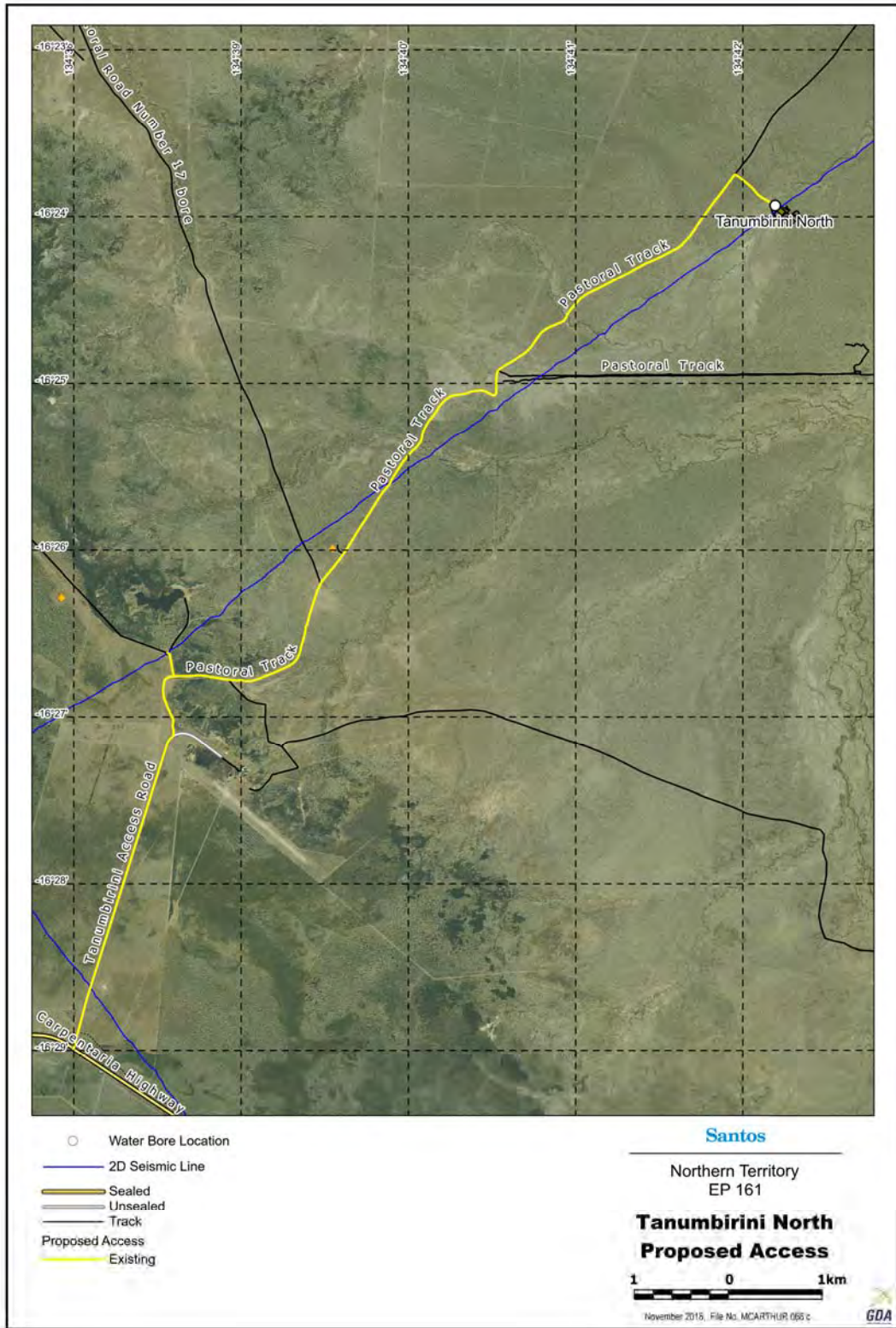


Figure 3-2 Proposed project footprint

### 3.3 Timing and Personnel

The water bore drilling and installation works will occur in November 2018. Monitoring of environmental baseline data will occur on an ongoing basis for the life of petroleum activities. All activities associated with this EMP will be restricted to daytime hours only.

### 3.4 Water Bore Program Specifications

All water bores will be constructed in accordance with the established guidelines that are in place for installation of water bores (refer <https://nt.gov.au/environment/water/bores-drilling-and-dams>). Water bore drilling activities will include installation of up to two (2) water bores at the one lease pad. Water bores will notionally be 120-200m deep x 155mm diameter casing with a pump installed to supply 4 Lt/s, using a suitably licenced water bore driller as per the NT Water Act. This includes:

- Mobilisation and demobilisation from site;
- Supply and install 219mm casing, cemented in place;
- Supply, slot and install 155mm steel casing, cemented in place;
- Collection of strata samples as per regulatory requirements (need to be 250g secured in sealed bags);
- Installation of Electric Submersible Pump (ESP) or “Positive Displacement Cavity” (Mono) pump matched to the water quality and temperature;
- Installation of headworks. In order to be used as level monitoring point will need an access point in the headworks and a ~30mm ID poly pipe conduit run so well can be safely dipped.
- Submission of Statement of Water Bore as per regulatory requirements.

Ongoing baseline environmental monitoring and aquifer testing may be conducted, including abstraction of ground water from existing (if available) and new water bores. Abstraction of ground water at the proposed monitoring bores will only be done for the purposes of groundwater monitoring.

### 3.5 Water Bore Lease Pad

**The water bore lease pad at Tanumbirini North has been located in an area of previous disturbance and no significant vegetation clearing is required (See**

Figure 3-3). The majority of the disturbance at the well pad is temporary and is required only to access the water bore lease pad, provide equipment working areas and provide enough room for the drill rig to turn around.

Figure 3-4 shows an indicative water bore lease pad layout, noting that lease The maximum estimated extent of disturbance associated with the water monitoring bore lease pad is 0.785 ha. This allows for the 50m x 50m (0.25 ha) drilling pad layout as well as rig turnaround areas and connection to the access track.

Following the drilling event a surface disturbance area of approximately 100m<sup>2</sup> (10m x 10m) will remain to facilitate access to the bore for groundwater monitoring events. This cleared area will remain in place for the life of the monitoring program.

A fence will be installed around the bores to ensure access by cattle is prohibited.



Figure 3-3 Tanumbirini North lease pad

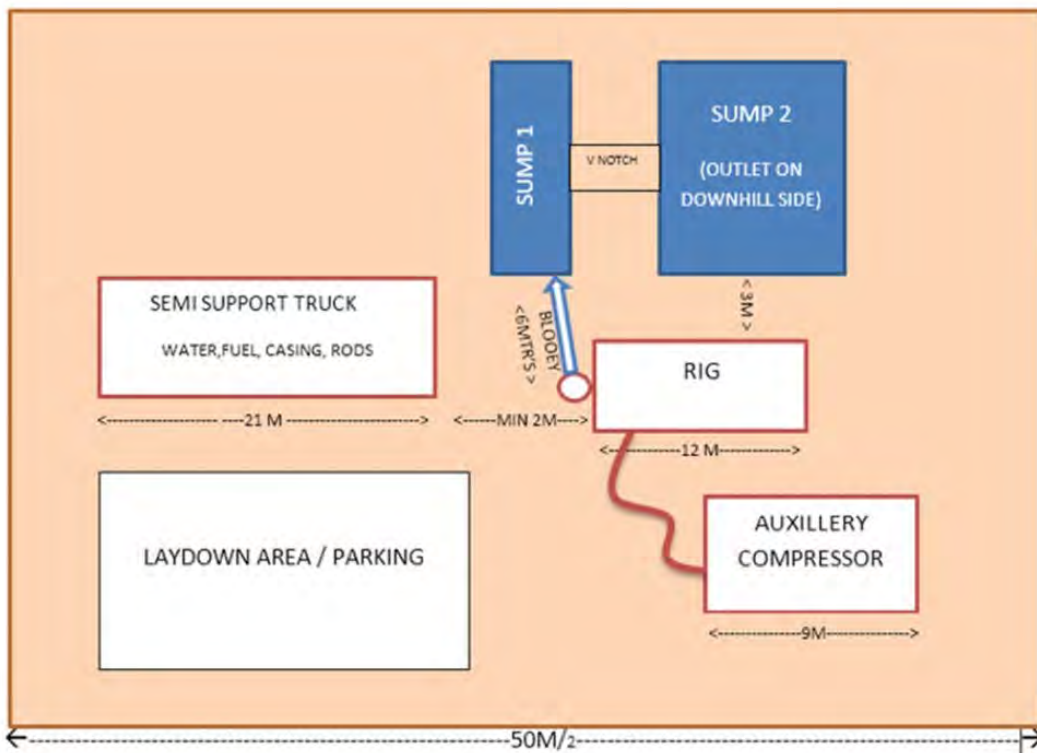


Figure 3-4 Indicative water bore lease pad layout



### 3.6 Road Access

Access to the water bore locations will be done by utilising landholder access tracks that are in useable condition and no upgrades are required. The location of the proposed access tracks used is shown in Figure 3-2.

No clearing is required and the use of borrow pits is not required as no fill or gravel is required for the minimal works.

### 3.7 Drilling Fluids

Local licenced and qualified drilling contractor with experience in the NT will be used for the water bore program. Detailed of the qualified drilling contractor will be sent to DPIR once the contract has been awarded. Material Safety Data Sheets (MSDS) for all products/additives will be sent to DPIR once the contract has been awarded and the fluids are known.

Licensed water bore drillers are required to choose drilling fluids that help the drilling process, remove cuttings from the borehole and limit damage to formations. Typically air and foam are used as the drilling fluid medium. Licensed water bore drillers are also required to not add chemicals and other drilling fluid that can leave a residual toxicity to any drilling fluids or cement slurries such as grout. Typical chemicals include:

- Water
- Foaming agents
- Liquid viscosifiers (polymers)
- Cement.

### **3.8 Figure Operations Support Facilities**

#### **3.8.1 Accommodation camp**

Accommodation will be provided at Tanumbirini homestead. A temporary camp is not required.

#### **3.8.2 Waste Management**

Waste containers and packaging associated with the water bore drilling will be disposed of as municipal waste.

Wastepaper, cardboard and food scraps are disposed of into sealed bins set up adjacent to the camp area. The sealed bins will be transported regularly for disposal of waste to a licensed landfill. Recyclable materials will be segregated on site and regularly transported to an approved waste depot facility (likely in Katherine).

#### **3.8.3 Water Use**

Water will be sourced from existing bores (Tanumburini 1 and Tanumbirini 13) with the permission of the Tanumbirini station owners and on-site portable tanks may be used. The water from these bores has previously been subject to several water tests carried out to ensure that there were no contaminants. The test results show that the water from this bore is clean and fit for drinking purposes. Water use for the project will be approximately 10kL.

Dust suppression is not required given the minimal traffic movements, minimal civil works and the good road conditions associated with the water bore project.

### **3.9 Planned and Unplanned Activities**

Environmental aspects are elements of the activity which can interact with the environment. These environmental aspects have been identified both for planned (routine and non-routine) and unplanned (accidents/incidents) activities. Unplanned activities that are considered in this process should be those with a reasonable potential to occur (i.e. a credible event).

Planned and unplanned activities identified for the water bore monitoring program are listed below.

Planned activities:

- Physical Disturbance
- Atmospheric Emissions
- Noise

Unplanned activities:

- Fauna interaction
- Erosion
- Introduction of Pests and Pathogens
- Fire
- Disturbance to Stakeholders
- Waste and Chemical Leaks

**3.10 Closure**

On completion of the water bore drilling program, access tracks and lease pads will remain in place to allow safe access to the ground water bores for environmental consultants. Final inspection will ensure no rubbish remains on site. At completion of the water bore drilling program and during the groundwater sampling events a general inspection for weeds and erosion will be completed.

Where decommissioning is required it will be undertaken in accordance with the *Minimum Construction Requirements for Water bores in Australia*.

## 4.0 DESCRIPTION OF EXISTING ENVIRONMENT

This section describes the physical, biological, cultural and socio-economic environment and identifies any relevant values and sensitivities of the environment that may be affected by the activity (referred as the 'project area'). The project area is shown in Figure 3-1.in.

The information has been sourced using field assessment reports commissioned by Santos and publicly available information and the Australian Government Protected Matters Search Tool (PMST) (Appendix 1) and NT NRM Report (Appendix 2). The identified environmental values and / or sensitivities with the potential to occur within the project area are summarised in Table 4-1.

**Table 4-1 Environmental values and/or sensitivities with the potential to occur in the vicinity of the project**

Environment Receptor	Summary
Groundwater	The Beetaloo Basin is overlain by the Georgina Basin, a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional significance. The CLA is a regional scale aquifer that provides groundwater resources for pastoral enterprises, domestic bores at homesteads and town water supplies at a number of small communities across the region. The CLA will be the target of the baseline environmental water monitoring required by this EMP.
Surface water	No rivers are present in the immediate project area. The water bore is located in the vicinity of an unnamed second order tributary of Tanumbirini Creek. Two sacred sites associated with waterholes are located in the vicinity of the project area.
Native fauna	There are six birds, four mammals and one reptile listed as threatened under the EPBC Act that are modelled as likely or known to occur or within 10 km of the project area. In addition, one reptile and one mammal listed under the TPWC Act has been recorded within 10 km of the project area. Threatened species have the potential to be found in the project area.
Native flora / habitat	The project area is covered by the Gulf Falls and Uplands Bioregion. No Threatened Ecological Communities (TECs) or threatened flora listed under the EPBC Act and/or TPWC Act are known to occur within 10 km of the project area.
Environmentally sensitive sites	Bullwaddy Conservation Reserve is located approximately 40 km west of the project area and south of the vehicle access track. Bullwaddy Conservation Reserve represents the only declared conservation area within the Sturt Plateau region of the lancewood/bullwaddy vegetation type.
Culturally sensitive sites	AAPA sacred sites are recorded within 3 km of the project area. Conditions of AAPA Authority Certificate C2014/053 specify restricted works areas associated with those sacred sites. NLC sacred site avoidance survey identifies two NLC recorded sacred sites north of the project area. No sacred sites are known to occur within the project area.
Landholders	The project is located on the Tanumbirini property. The Tanumbirini Homestead, located approximately 8.5 km southwest of the proposed water bore.

## 4.1 Natural environment

### 4.1.1 Climate

The water bores is located in the Top End of the NT and experiences two distinct seasons: a wet season (October to April) and dry season (May to September). Table 4-2 shows a summary of climate records for McArthur River Mine (MRM) Airport (Station 014704). The station is located approximately 100 kilometres (km) east of the project area.

The mean annual rainfall for MRM Airport is 760 mm (based on record averages between 1968 and 2018) (BOM 2018). A majority of rainfall is recorded December to January. The mean maximum temperature ranges between 30 – 35 (°C) in the dry season and between 35 to 38 (°C) in the wet season. The mean minimum temperature ranges between 12 - 17 (°C) in the dry season and between 20 – 25 (°C) in the wet season.

Generally average monthly evaporation exceeds average monthly rainfall in the dry season and the average monthly rainfall exceeds average monthly evaporation in the wet season. The mean annual evaporation rate at MRM Airport is 90 mm.

**Table 4-2 Temperature and rainfall records for BoM Station #014704**

Month	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature													
Mean Daily Max (°C)	35.9	35.3	35.1	34.8	32.4	29.9	30.1	32.1	35.4	38.7	33.6	37.6	34.6
Mean Daily Min (°C)	25.0	24.7	23.5	20.7	16.7	12.7	12.3	13.4	17.3	21.1	24.2	25.0	19.7
Rainfall													
Mean monthly (mm)	220.7	180.7	144.9	31.1	7.3	1.7	2.2	0.3	5.0	19.8	56.5	125.2	764.3

### 4.1.2 Geology

The McArthur Basin covers approximately 180,000 km<sup>2</sup> and comprises a mixed carbonate-silicilastic succession with minor volcanic units near the base. Rock types include quartzose sandstone, mudstone, dolostone and minor mafic and felsic volcanic rocks. Depositional environments range from fluvial and lacustrine to shallow marginal marine in an overall intracratonic setting. Overall the region to the west is flat to gently undulating with little local relief, while the region to the east towards the gulf coast includes dissected sandstone plateaux. The geology of the project area is shown in Figure 4-1.

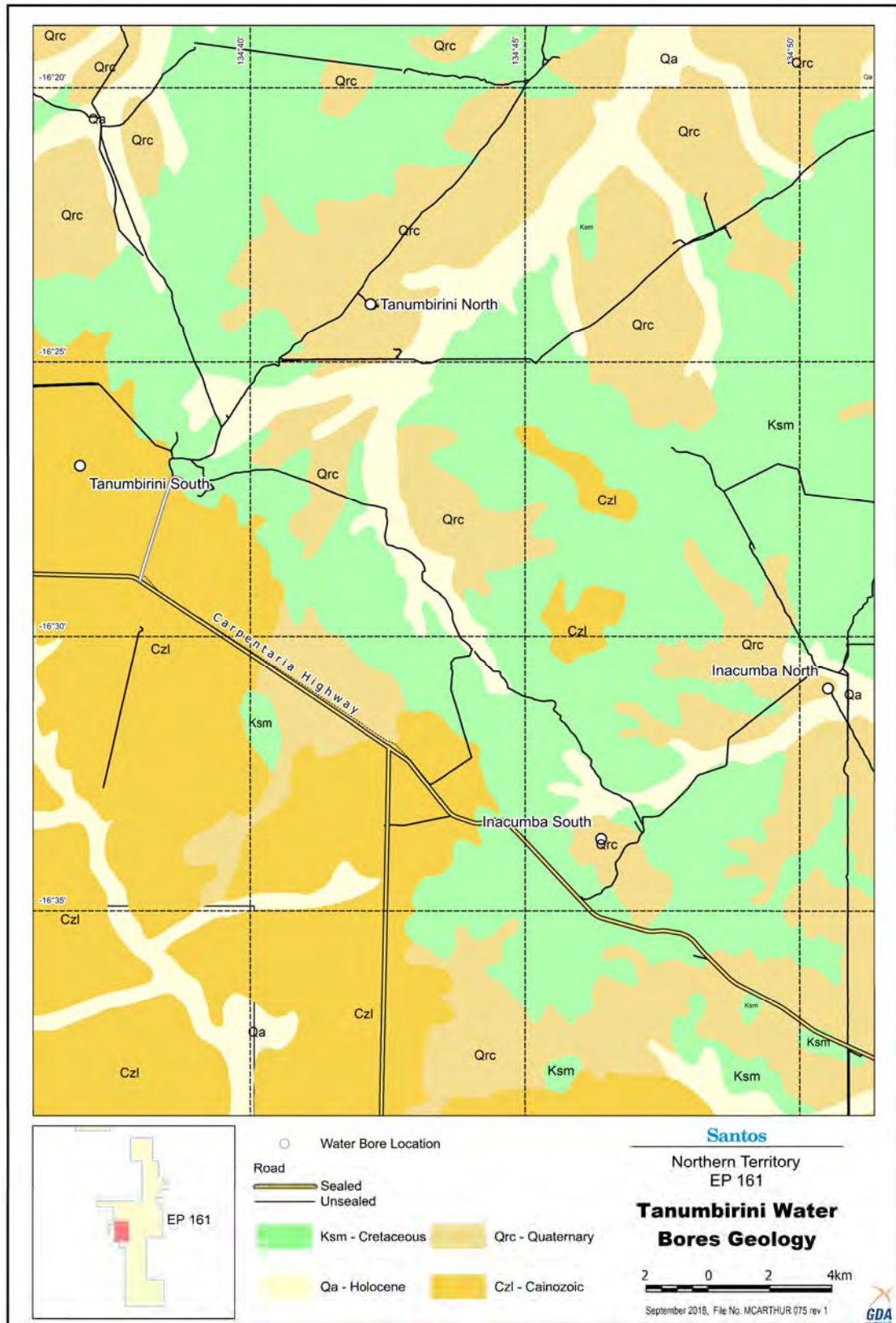


Figure 4-1 Geology in the vicinity of the Tanumbirini well

### 4.1.3 Soils

The landscape of northern and central Australia is ancient and highly weathered. Soil types are susceptible to erosion given that the region experiences long dry periods followed by intense rainfall. In this environment, the soils become disturbed and once disturbed can be easily eroded.

The project area soils are dominated by kandosols and rudosols (Appendix 2). Rudosols are very shallow soils or those with minimal soil development and includes very shallow rocky and gravely soils across rugged terrain.

Kandosols are massive and earthy soils (formerly red, yellow and brown earths) that are widespread across the Sturt plateau regions.

The proposed Tanumbirini North water bore is located within the Tanumbirini land system detailed in Table 4-3, and shown in Figure 5-2.

**Table 4-3 Percentage of land systems and total area within the project area**

Land System	Landscape Class Description	Soil Description
Tanumbirini	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	Lateritic yellow earths and brown clays



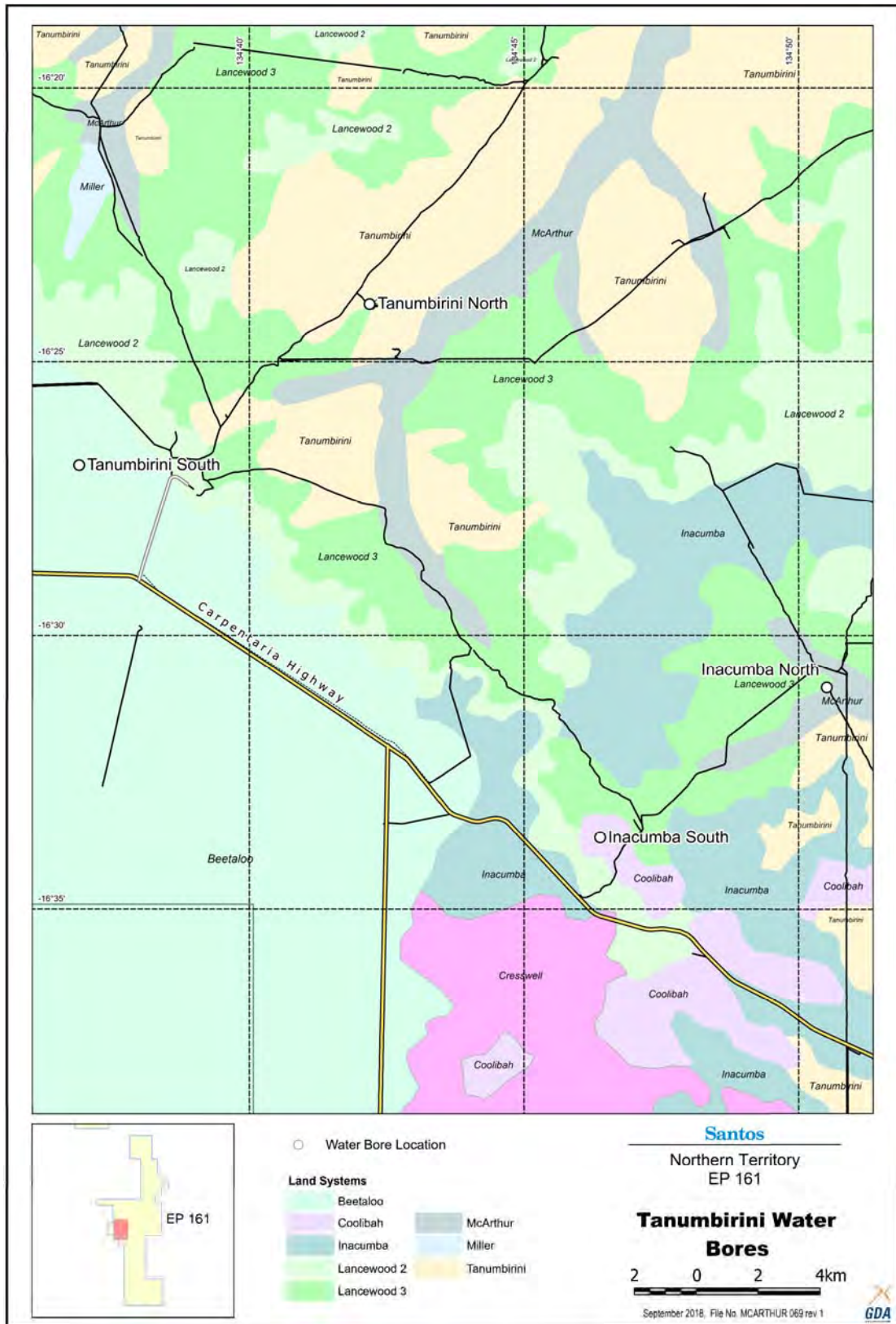


Figure 4-2 Land systems within the project area



## **4.2 Baseline water conditions**

### **4.2.1 Surface Hydrology**

The majority of the catchments in the region drain north-easterly towards the Gulf of Carpentaria (Figure 5-3). Major rivers include the Limmen Bight River, October Creek and Cox River. The highest flows for these rivers occur during the wet season, predominantly due to cyclones and monsoonal rainfall. In contrast to these larger rivers, smaller streams and drainage lines such as the Tanumbirini Creek and Inacumba Creek are largely ephemeral and usually run dry during the dry season. Ephemeral rivers and streams are subject to short flow duration and high turbidity.

The creek systems in the vicinity of the Tanumbirini North water bore are shown in Figure 4-3.

There is also a range of small wetlands associated with sinkholes and minor depressions in the generally flat landscape. Riparian zones of these rivers and wetlands are generally in fair to good condition, affected mostly by access by livestock and feral animals and weeds.

Two waterholes are adjacent to the broader project area access track and are recorded sacred sites (refer to section 5.4.3).

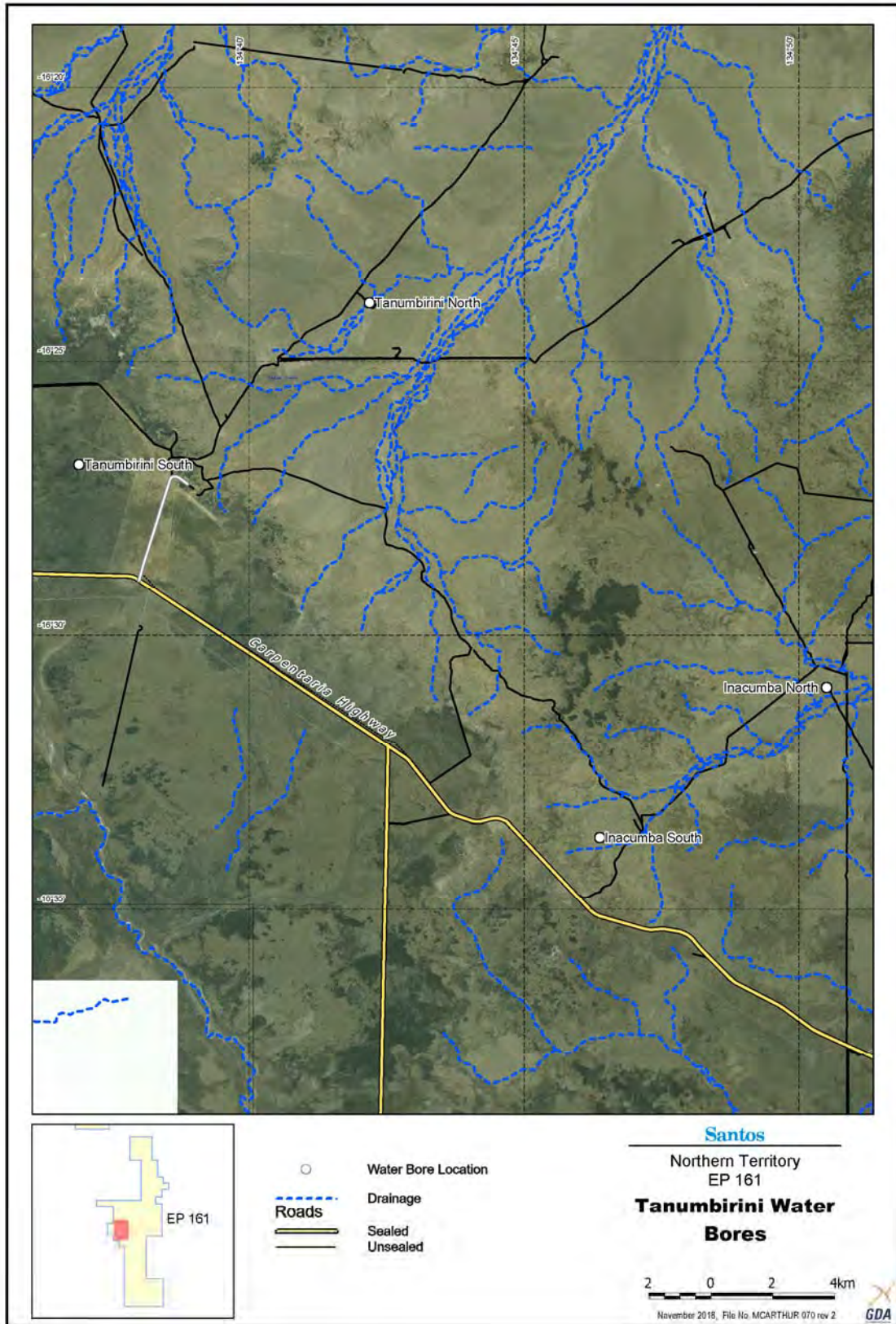


Figure 4-3 Watercourses within the project area

#### 4.2.2 Groundwater

The Beetaloo Basin comprises a thick sequence of flat-lying mudstone and sandstone formations (Roper Group) which is estimated to reach 5000 m in thickness in the centre of the basin and with the exception of the north and eastern margins occurs at an average depth of about 500 m. The Roper Group is overlain by the Georgina Basin, which comprises widespread basalts and a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional significance.

The CLA is currently utilised for pastoral properties, domestic bores at homesteads and the town water supplies from a number of small communities in the region. Table 4-4 has been adapted from the Final Report and details the status of knowledge about shallow aquifers relevant to the proposed water monitoring bore locations.

**Table 4-4 Status of knowledge about shallow aquifers**

Shale Basin	Aquifer	Summary
The McArthur Basin Beetaloo Sub-basin East of Stuart Highway	Tindall /Gum Ridge (CLA)	<p>Is the only known aquifer in this region - average depth to the formation is 30 m.</p> <p>Water table is approximately 45 m deep and aquifer expected to be intersected within 15 m of the top of the water table (that is at 60 m).</p> <p>Most of the region is covered by low permeability cretaceous sediments.</p> <p>Surface expression of collapse structures in the underlying limestone exist, but open sinkholes that provide a preferential pathway to the aquifer are rare.</p>

#### **Local Groundwater Monitoring Results**

Santos commissioned an audit to baseline groundwater conditions and bore infrastructure across the central portion of EP 161 in 2017. Results of the baseline survey informed the development of a groundwater monitoring plan for EP 161. The plan details the groundwater monitoring activities that will be undertaken in two discrete sampling rounds timed to coincide with the start and end of the 2018 dry season. Sampling of groundwater levels and quality is ongoing. This activity is scheduled every six months, with the next event scheduled for October 2018.

Groundwater quality samples were collected from equipped pastoral bores on Tanumbirini Station via sampling taps located on the bore headworks. Groundwater samples were analysed for water levels and water quality parameters: alkalinity and hardness, major cations and anions, fluoride, metals (dissolved and total) and dissolved methane. A brief summary of the results of this monitoring is provided below:

- With the exception of one groundwater bore the groundwater levels in May 2018 are near identical to the August 2017 baseline results. .
- There is little variation in water quality parameters between the 2017 baseline and the 2018 samples which is consistent with the extensive, regional nature of the aquifer.

The monitoring associated with this EMP is expected to support the water levels and water quality results captured during the Santos EP 161 Groundwater Monitoring events.



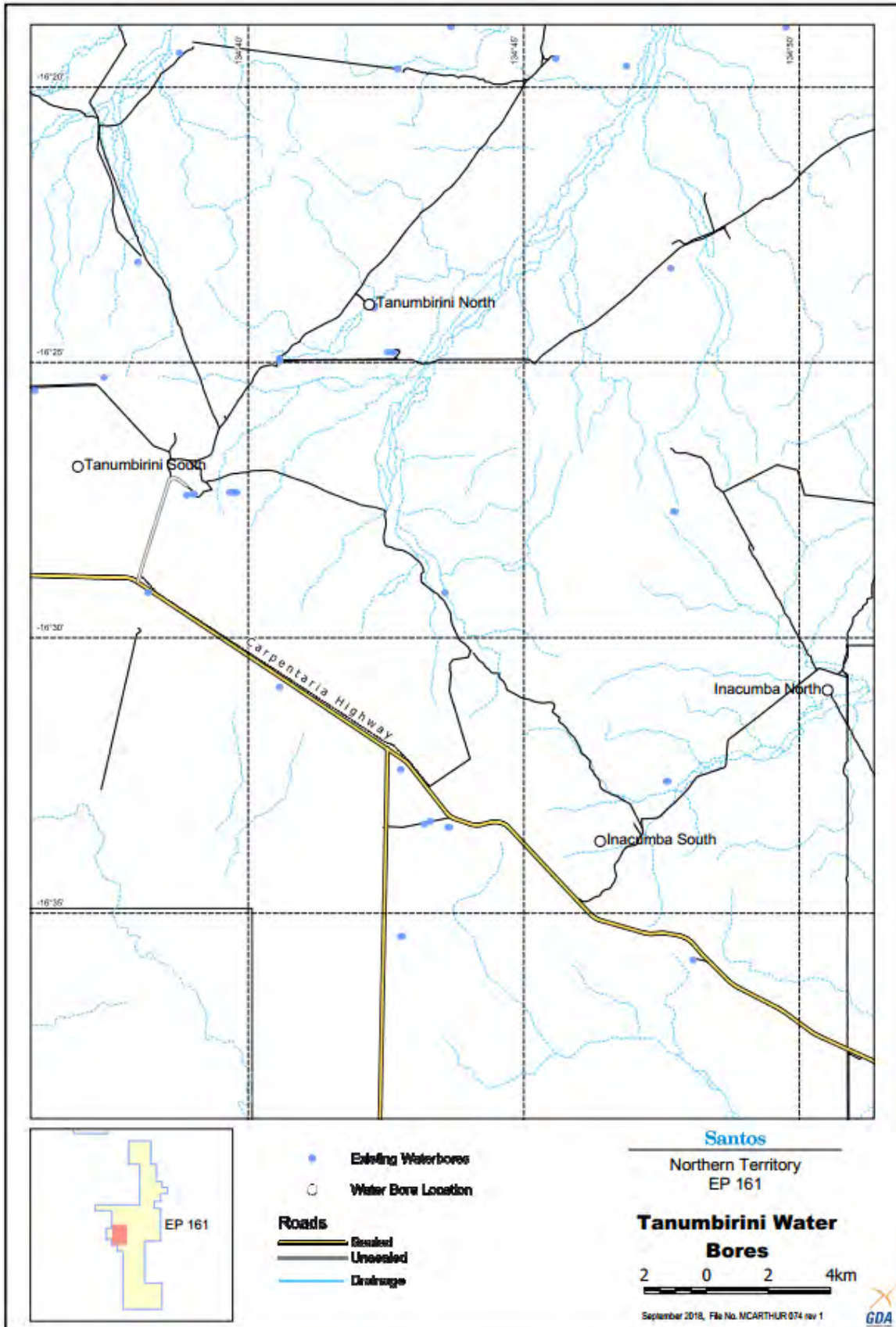


Figure 4-4 Groundwater bores within the project area

## 4.3 Biodiversity

### 4.3.1 Bioregions

The EP-161 is covered by the two following Bioregions:

- Gulf Falls and Uplands Bioregion, predominantly in the northern portion of EP-161
- Sturt Plateau Bioregion, predominantly in the southern part of EP-161

Three of the water monitoring bores (Tanumbirini North, Inacumba North and Inacumba South) are located within the Gulf Falls and Uplands Bioregion. The Tanumbirini South water monitoring bore is located within Sturt Plateau Bioregion (Figure 4-5).

#### ***The Gulf Falls and Uplands Bioregion***

The Gulf Falls and Uplands Bioregion covers an area of 118,480 km<sup>2</sup> and includes spectacular gorges, water holes and dissected sandstone plateaus. Vegetation is predominantly eucalypt woodlands over spinifex grasslands. Cattle grazing and mining are the main industries. Other land uses include Aboriginal land and conservation reserves. Major population centres are Borroloola and Ngukurr (DoEE 2008a).

Key features and issues of the Gulf Falls and Uplands bioregion include the following:

- Major infrastructure developments have occurred in the past 10 years, resulting in increased stock numbers in the bioregion.
- Landscape function and land condition more generally have improved due to better fire management, destocking of some properties and overall infrastructure development, leading to better herd control.

#### ***Sturt Plateau Bioregion***

The Sturt Plateau bioregion comprises flat to gently undulating plains with little local relief. The vegetation is mainly eucalypt forests and woodlands dominated by bloodwoods over perennial grasses. The main land use and industry is cattle grazing. Major population centres are Larrimah and Daly Waters (DoEE 2008b).

- Key features and issues of the Sturt Plateau bioregion include the following:
- Weeds spreading along and away from the new Alice Springs–Darwin railway corridor have introduced a new threat to the bioregion.
- Further development of infrastructure across the Sturt Plateau has led to:
  - opening up of new areas with the use of polythene pipe and tanks to reticulate stock water and better distribute grazing
  - strategic location of waterpoints – a reduced number and intensity of wildfires

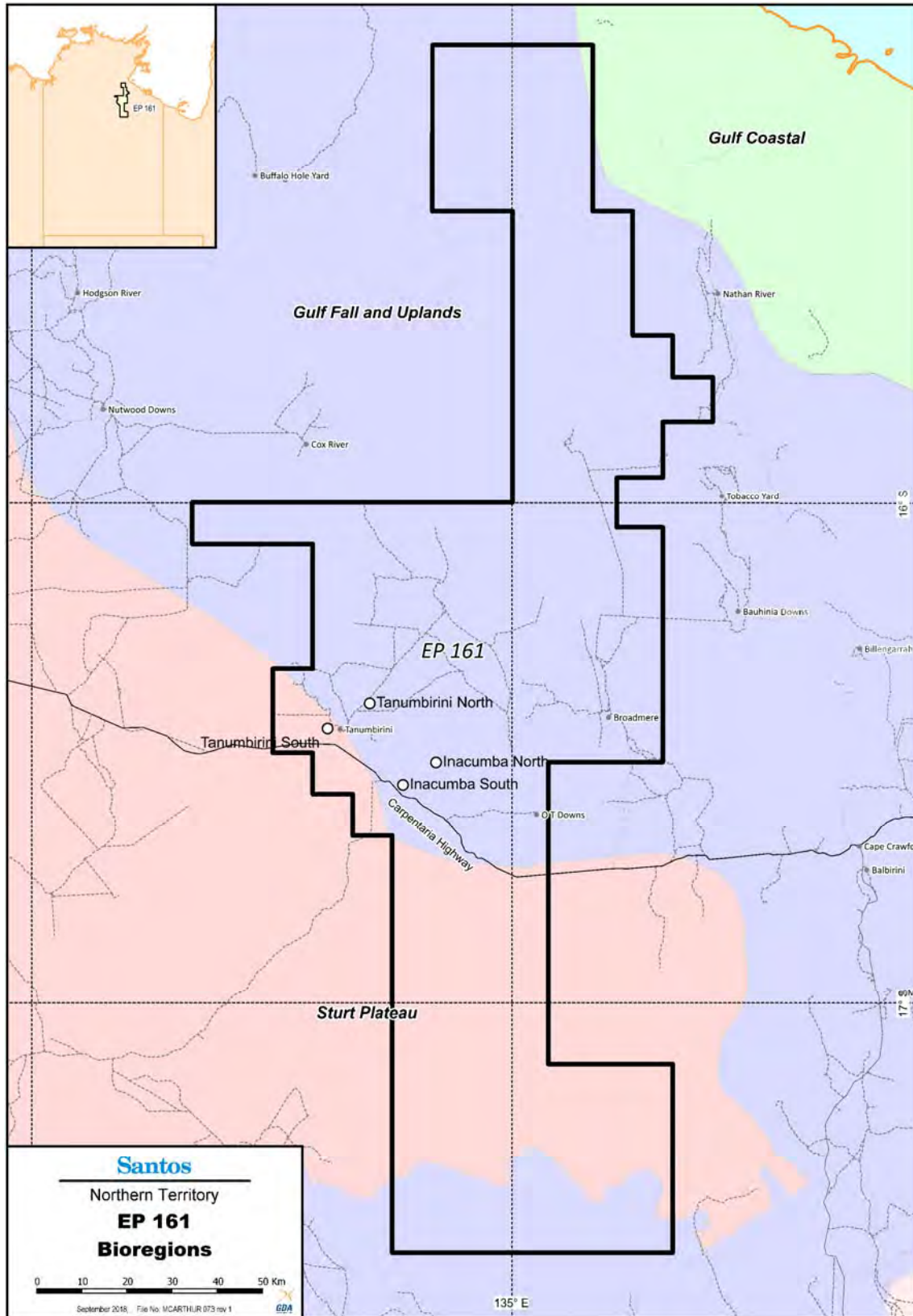


Figure 4-5 Bioregions within the project area

### 4.3.2 Vegetation and Flora Species

A search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) (DoEE 2018) was undertaken to identify any Matters of National Environmental Significance that are likely to occur within 10 km of the project footprint. The search results are attached in Appendix 1. No Threatened Ecological Communities or threatened plant species were reported.

A search of the NT Flora Atlas was completed to determine threatened flora species records within 10 kilometres of the project area. No threatened flora species are recorded within 10 km of the project area.

The vegetation type within 10 km of the project area are woodland open forest and tussock grassland as shown in Figure 4-6. Figure 5-5. The dominant vegetation type in the immediate area of the Tanumbirini project area is woodland. The dominant species within the woodland vegetation communities present is dominated by Kullingal *Eucalyptus pruinosa* and variable barked Bloodwood *C. dichromphloia* with *Melaleuca* spp. with tussock grass understorey.



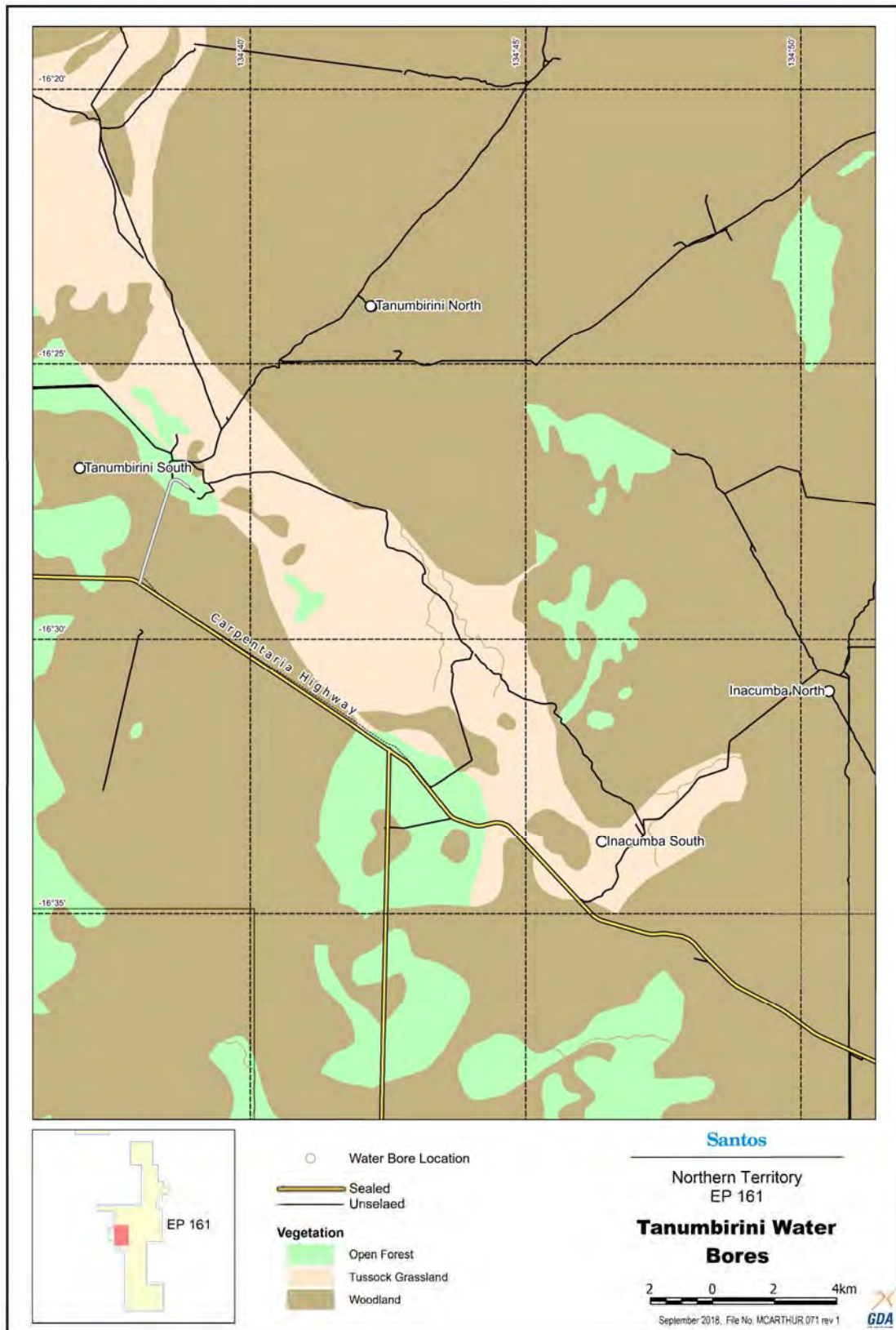


Figure 4-6 Vegetation types within the project area



### 4.3.3 Groundwater dependent ecosystems

A search of the National Groundwater Dependent ecosystems (GDE) Atlas (BoM 2012) was conducted 26 September 2018. The dataset expresses the potential for groundwater interaction/use for river/spring/wetland ecosystems across Australia. It shows the ecosystems that rely on groundwater that has been discharged to the surface, such as baseflow or spring flow.

No data was available about subterranean GDEs in the project area. A low to moderate potential of terrestrial GDEs is associated with Inacumba and Tanumbirini creeks and waterholes in the area. No terrestrial GDE appear to be within the project area..

### 4.3.4 Fauna Species

A search of the PMST database (DoEE 2018) was undertaken to identify Matters of National Environmental Significance likely to occur within 10 km of the Tanumbirini project area (Appendix 1). The PMST Report identified 6 birds, 3 mammals and 1 reptile that are listed threatened species which may occur within 10 km of the project area. No listed insects were reported.

This fauna species included:

#### Birds

- 'critically endangered' Curlew Sandpiper (*Calidris ferruginea*)
- 'endangered' Gouldian Finch (*Erythrura gouldiae*) and Australian Painted Snipe (*Rostratula australis*)
- 'vulnerable' Red Goshawk (*Erythrotriorchis radiatus*), Crested Shrike-tit (northern) (*Falcunculus frontatus whitei*), and Masked Owl (northern) (*Tyto novaehollandiae kimberli*).

#### Mammals

- 'vulnerable' Ghost Bat (*Macroderma gigas*), Greater Bilby (*Macrotis lagotis*), Carpentarian Antechinus (*Pseudantechinus mimulus*) and Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudicluniatus*).

#### Reptiles

- 'endangered' Gulf Snapping Turtle (*Elseya lavarackorum*).

The NT NRM Report generated Mon September 24 from NT Infonet (<http://www.infonet.org.au>) was used to identify threatened species listed under the TPWC Act (Appendix 2). One threatened species, Mertens' Water Monitor (*Varanus mertensi*) listed as vulnerable, has been previously recorded within 10 km of the project.

The Report also assess large scale species distributions grid cells. The grid cells for the Carpentarian Antechinus (*Pseudantechinus mimulus*), which is Vulnerable under the EPBC Act, overlap the project area (Appendix 2).

The PMST Report identified 12 migratory species potentially occurring 10 km from the project area, with the Curlew Sandpiper (*Calidris ferruginea*) listed as a 'critically endangered' migratory wetland species. The PMST Report also identified 19 listed marine species, which included the Curlew Sandpiper and the 'endangered' Painted Snipe (*Rostratula benghalensis*).

### 2018 Ecological Field Assessment

An ecological desktop assessment conducted in 2017 by EcOz identified the Gouldian Finch (*Erythrura gouldiae*) as having a medium chance of occurring with the survey area. Further habitat assessment and mapping for this species was conducted during the 2018 ecological work program for EP 161. The ecological report including is provided in Appendix 3.

No threatened species were observed during surveys. Habitat area for the Gouldian Finch were observed characterized by patches of Snappy Gum (*Eucalyptus leucophloia*) represented typical open-woodland to woodland vegetation communities. However, the number of hollows present within the *E. leucophloia* trees at site is low and the observed patches do not present optimal habitat for the Gouldian Finch and it is unlikely that the species utilises this area for nesting.

### 4.3.5 Pest Plant and Animals

#### Pest Plants

Pest plant and animals are a significant land management issue in the Northern Territory. The PMST database identified one Weeds of National Significance (WONS) as potentially occurring within 10 km of the project area, Prickly Acacia (*Acacia nilotica* subsp.) (Appendix 1). The Katherine Regional Weed Management Plan 2015-2020 (Weed Management Plan) (DLRM 2015) includes the project areas. The Weed Management Plan identifies priority weeds within the region (See Table 5.4)

**Table 4-5 Priority weeds within the Katherine Region Weed Management Plan**

Species	Declared Class	Weed of National Significance (WoNS)
Mesquite - <i>Prosopis</i> spp.	A/C	Y
Prickly acacia - <i>Vachellia nilotica</i>	A/C	Y
Parkinsonia - <i>Parkinsonia aculeata</i>	B/C	Y
Chinee Apple - <i>Ziziphus mauritiana</i>	A/C	-
Mimosa - <i>Mimosa pigra</i>	A/C	Y
Bellyache Bush - <i>Jatropha gossypifolia</i>	A/C	Y
Gamba Grass - <i>Andropogon gayanus</i>	A/C	Y
Neem - <i>Azadirachta indica</i>	B/C	-
Grader grass - <i>Themeda quadrivalvis</i>	B/C	Y
Snake weed - <i>Stachytarpheta</i> spp.	B/C	-
Devils Claw - <i>Martynia annua</i>	A/C	-

Data provided by Department of Environment and Natural Resources, (DENR) Weed Management Branch indicates that five declared weeds have previously been recorded within the vicinity of the site:

- Noogoora Burr
- Parkinsonia
- Gamba Grass
- Hyptis
- Grader grass

The growth and spread of Class B species must be controlled. All declared weeds are a Class C weed and are not to be introduced into the NT.

### ***Baseline Weed Assessment***

In response to Recommendation 8.2 of the Final Report a baseline weed survey was undertaken between the 8th – 11th August by a team of EcOz Environmental Consultants, all with experience in surveying weeds and vegetation in the Northern Territory. The ecological report including the baseline weed assessment is provided in Appendix 3

The baseline weed survey recorded 48 occurrences of a total of five declared weed species. The number of occurrences of each weed species is shown in Table 3-3, the location of weed records is shown on Figure 3-3. The majority of weeds occurred along station tracks.

Hyptis was the most abundant weed recorded, with 35 records, and the broadest distribution. Hyptis was recorded primarily along access tracks and at watering points, but there were a few small patches of low density recorded. One patch of Rubber Bush was found in paddocks adjacent to an access track. The patch was relatively dense in a disturbed area, and appear to extend into the paddock to the south west. Individuals in the patch were flowering and 4 plants were observed to have seed present. It is likely that seed is contained in the soil in the access track adjacent to the infestation. Although not declared at this location, it is a declared weed south of the Carpentaria Highway and can cause significant environmental and financial damage.

This baseline assessment covers the proposed Tanumbirni North water bore location.

### ***Pest Animals***

Nine prohibited fauna species are also identified as occurring within 10 km of the project area (refer Appendix 1, 2 and 3). Pest animals identified in the project area are cane toads, cattle, house sparrow, buffalo, dog, donkey, cat, horse and pig.

### **4.3.6 Fire Regime**

Aboriginal people have traditionally used fire as a tool during hunting and gathering. These fires have shaped vegetation and faunal patterns across central Australia. The advent of pastoralism brought new approaches regarding fire use resulting in fewer but larger fires initiated during the warmer seasons.

Fire management or controlled burns within the region are a common occurrence. Controlled burns are undertaken to reduce the possibility of uncontrolled fires and to assist in land management. Fire management in the region considers the various land uses including pastoral use, tourism and other industry including oil and gas activities.

The peak fire season for the region is during the late dry season. At this time, rainfall is usually very low, and previous wet season growth has produced now near-dry vegetation available to fuel potential bushfires. Periods of increased temperature and reduced rainfall and humidity due to climatic cycles such as El Niño can exacerbate these conditions.

The NT NRM Report (Appendix 2) indicates fire frequency in the immediate vicinity of the project area is three or less between 2000 and 2017.

## **4.4 Cultural Environment**

### **4.4.1 Historic and Natural Heritage**

A search of the *PMST* database (DoEE 2018) showed no World Heritage Properties or National Heritage Places are registered within 10 km of the project area.

In addition, a search of the NT Heritage Register (DTC 2018) for NT Portion 701 (on which the Tanumbirini project area is located) was conducted and no recorded NT listed heritage items or places are present in the project area.

### **4.4.2 Sacred Sites**

Areas of significance for sacred sites is considered through the process of securing a sacred site clearance certificate (SSCC) from the Northern Land Council (NLC) and an Authority Certificate from the Aboriginal Areas Protection Authority (AAPA). This process aims to prevent damage to, and interference with sacred sites, by identifying and setting out the conditions for entering and working on the land.

#### **NLC**

A sacred site avoidance survey of EP-161 work program area was completed by NLC and Traditional Owners in 2013-14-16. Two sacred sites within the EP were located approximately 50 km north of the proposed Tanumburini North water monitoring bore.

#### **AAPA**

Santos has obtained an AAPA Authority Certificate (C2014/053) for proposed works and activities to construct three wells (of which Tanumbirini is one), associated infrastructure, and seismic activities within EP-161. The subject land of AAPA C2014/053 includes the Tanumbirini well site.

\*\* Text Redacted\*\*

It is important to note that AAPA certification is in place for the proposed water bore location.

## 4.5 Socioeconomic environment

There is a range of current land uses throughout the area including conservation, tourism, oil and gas exploration and pastoral activities.

The EP-161 lease overlays two Local Government Areas; Barkly Shire to the south, and Roper Gulf Shire to the north. The Barkly Shire covers an area of 323,514 km<sup>2</sup> and has a population of approximately 7,531. The Barkly Shire includes the Barkly Tablelands, numerous Aboriginal land trusts and pastoral properties.

The Roper Gulf Shire covers an area of 186,000 km<sup>2</sup> and has a population of approximately 6,121. The Roper Gulf Shire includes 16 towns and communities of varying sizes, major roadhouses, 22 outstations and 50 pastoral properties.

The local area remains generally undeveloped in terms of infrastructure and roads. Major infrastructure within EP-161 includes the Carpentaria Highway and the Daly Waters to McArthur River gas pipeline, which run approximately parallel with one another east-west through the southern half of the tenement. The McArthur River Mine is located approximately 100 km east of the project area.

The Carpentaria Highway is frequented as a tourist route in the Dry season, both as a route to destinations around the Gulf of Carpentaria, and as a link between the NT and Queensland.

### 4.5.1 Settlements

The closest towns to the project area are Daly Waters (approximately 130 km to the west) and Borroloola (approximately 180 km to the east) (Figure 3-1). The closest significant population centre is Katherine located approximately 350 km to the north-west.

The proposed Tanumbirini North water bore and access track are located on Tanumbirini Station.

## 4.6 Key environmental values and sensitivities

### 4.6.1 Protected or Conservation Areas

There are no protected or conservation areas within the project area (Figure 4-7). The closest protected area is Bullwaddy Conservation Reserve, approximately 40 km west of the project area.

Bullwaddy Conservation Reserve (NT Portion 5680) is located approximately 100 km east of Daly Waters along the Carpentaria Highway, and west of the project area. The Reserve is a declared conservation area within the Sturt Plateau region with the lancewood/bullwaddy vegetation type (including *Acacia* woodlands). The conservation of *Acacia* woodlands is severely under represented with less than 1% conserved in the Territory and 3% nationally (Bureau of Rural Sciences, 2004 cited in PWCNT 2005).

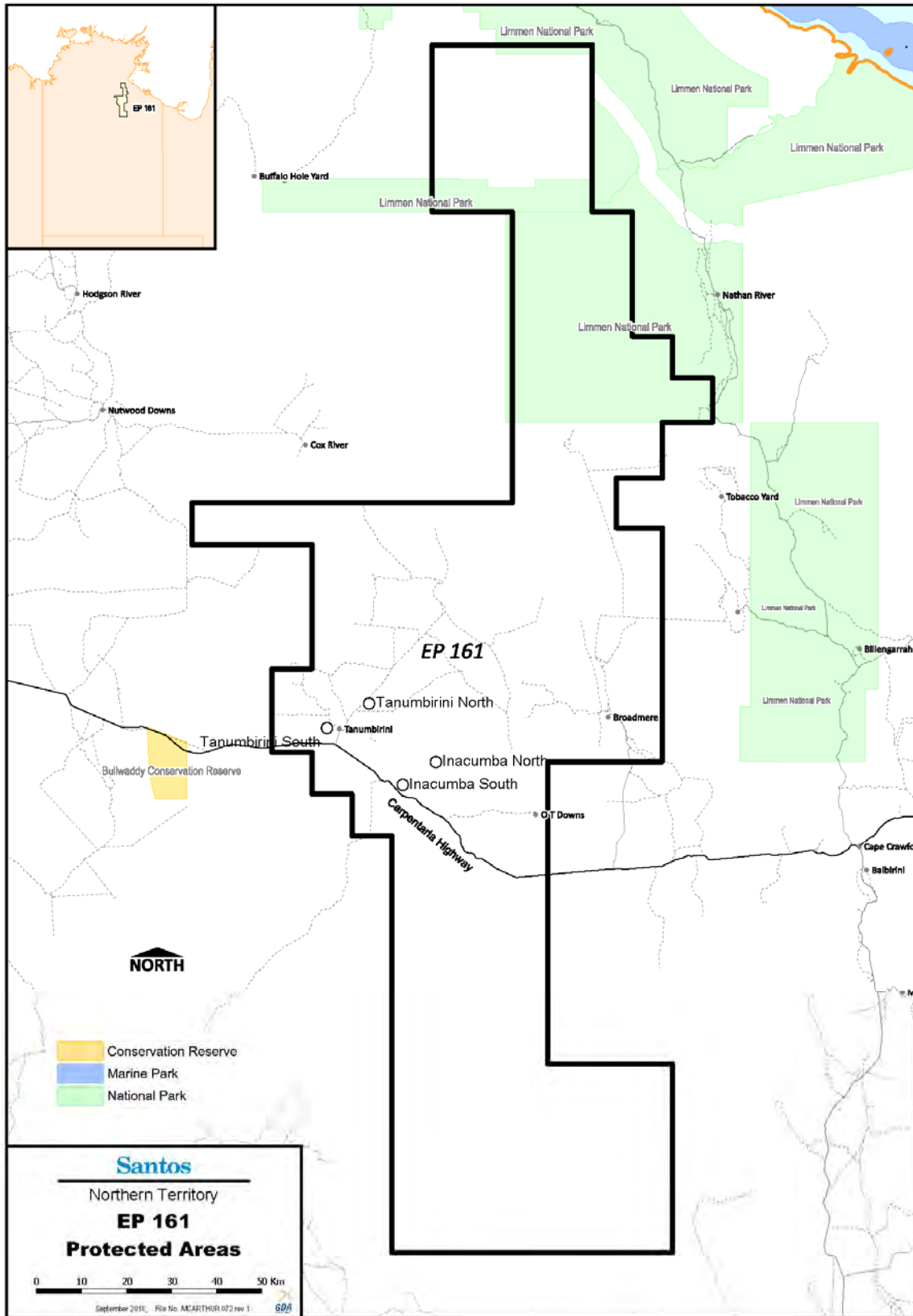


Figure 4-7 Protected and Conservation Areas

#### **4.6.2 Protected species**

A search of the PMST (DoEE 2018) was undertaken to identify listed threatened flora or fauna that may occur or are likely to occur within the project area (refer Section 5.3.3). These searches identified 6 birds, 3 mammals and 1 reptile may or are likely to occur within the project area (Search results provided in Appendix 1). The search did not identify any Threatened Ecological Communities in the area.

Twelve migratory species (all birds) that may or are likely to occur within the project area (Appendix 1). An additional nine listed marine species were also identified as likely or may occur within 10 km of the project area.

#### **4.6.3 Significant Habitat**

The PMST database identified no internationally or nationally important wetlands within 10 km of the Tanumbirini project footprint (Appendix 1).

In the NT there have been 67 sites identified as the most important sites for biodiversity conservation that need further protecting (referred to as Sites of Conservation Significance (SOCS)). No NT SOCS are located within 10 km of the project footprint. In addition, no Sites of Botanical Significance are located within 10 km of the project footprint.



## 5.0 OVERVIEW OF THE ENVIRONMENTAL RISK ASSESSMENT PROCESS

The Regulations operate around the concepts of environmental risks and environmental impacts. Environmental risk is defined as “*the chance of something happening that will have an environmental impact, measured in terms of the environmental consequences and the likelihood of those consequences occurring*”. Environmental impact is defined as “*any adverse change, or potential adverse change, to the environment resulting wholly or partly from a regulated activity*”.

It is acknowledged 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.

### 5.1 Process Overview

The planned and potential interactions between the described activity, the aspects triggered and the described environment represent a source of risk (or impact) which has potential to result in a change to the environment.

An Environmental Risk Assessment (ERA) involves assessment of the likelihood and consequence of these impacts. For the EMP to be accepted by the Minister for Primary Industry and Resources, it must be demonstrated that the environmental impacts and environmental risks will be reduced to a level that is ALARP and acceptable.

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.

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. In particular, demonstration that the principles of inter-generational equity and the maintenance of biological diversity and ecological processes is required.

To meet the requirements for ERA under the regulations, the principles of the risk management process of *AS/NZS ISO 31000:2009 Risk management – principles and guidelines*, in addition to *HB 203:2006 Environmental risk management - Principles and process* have been followed. The summary of this approach is:

1. Identification of environmental aspects
2. Description of the environment that may be affected
3. Identification of the particular values and sensitivities
4. Identification and evaluation of potential environmental impacts
5. Determination of the pre-treatment risk ranking
6. Control measure identification and ALARP decision
7. Determine severity of consequence
8. Determine likelihood
9. Determine residual risk ranking

## 10. Determination of acceptability

Section 6 'Environmental Risk Assessment', details the outcomes of this process.

### **5.2 Identification of Environmental Aspects**

Environmental aspects are identified as elements of the activity which can interact with the environment. Environmental aspects were identified for planned and unplanned activities and described in Section 3.0.

### **5.3 Identification of the environment that may be affected**

Following the identification of environmental aspects, the likely extent of each aspect is considered and the environment which may be affected determined. This area, the project area, is described within Section 4.0.

### **5.4 Identification of Particular Values and Sensitivities**

Based on Santos' and publicly available information a review of the existing environment (Section 4.0) was undertaken to identify the environmental values and / or sensitivities with the potential to occur within the project area. Table 4-1 provides a summary of these values and sensitivities. These were used to inform the risk assessment as they provide the potential worst-case consequence.

### **5.5 Identification and Evaluation of Potential Environmental Impacts**

The known and potential impacts of environmental aspects to the identified environmental receptors were identified. These were then evaluated and specifically considered:

- Receptor sensitivity to identified aspect; and
- Extent and duration of the potential impact.

### **5.6 Pre-treatment Risk Ranking**

Risk is expressed in terms of a combination of the consequence of an impact and the likelihood of the impact occurring (see Sections 5.7.2 – 5.10).

A pre-treatment risk ranking is identified to assist with the determination of the level of controls required to reduce the risk or impact to an acceptable level.

### **5.7 Control Measure Identification and ALARP Decision**

Based on the identified impacts, and the ranking of their pre-treatment risk, control measures were identified in accordance with the defined environmental performance outcomes, to eliminate, prevent, reduce or mitigate consequences associated with each of the identified environmental impacts. Control measures were identified through previous surveys, in workshops and through review of best practice techniques across the industry.

#### **5.7.1 ALARP Decision Framework**

When determining whether the risk or impact has been reduced to ALARP, it must be asked whether environmental risks can be lowered further without a grossly disproportionate increase in impost.

Santos’ approach to this decision is based on the Oil and Gas UK’s ‘Guidance on Risk Related Decision Making’ (Figure 5-1). This framework considers impact severity and several guiding factors to achieve ALARP risk demonstration:

- Activity type;
- Risk and uncertainty; and
- Stakeholder influence.

This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). Decision types and methodologies to establish ALARP are outlined in Table 5-1.

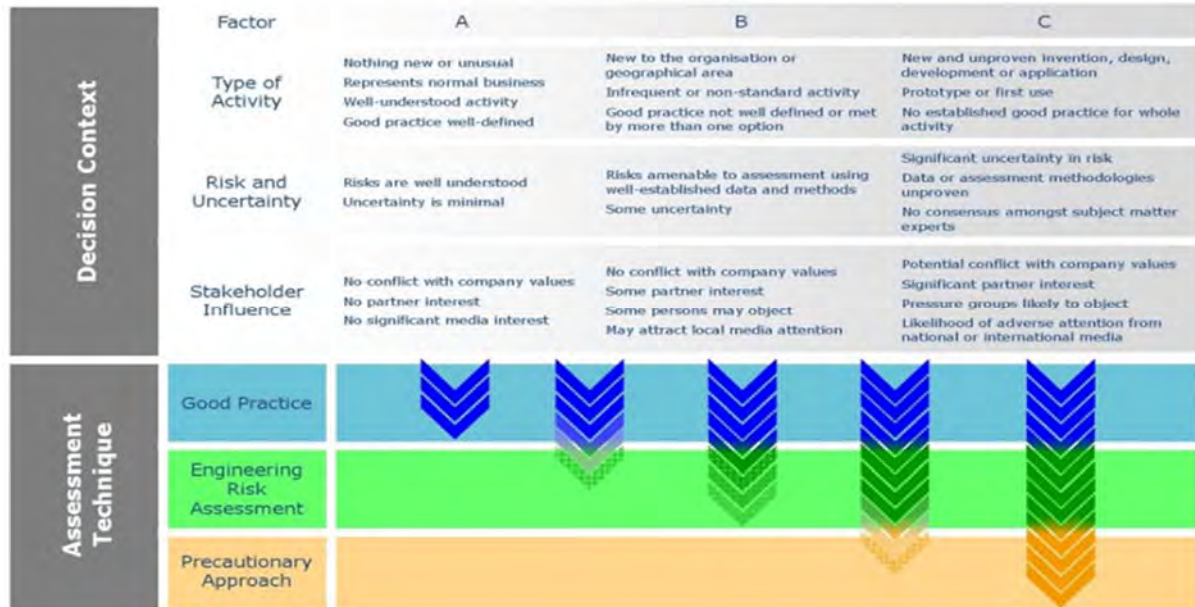


Figure 5-1 Impact and Risk ‘Uncertainty’ Decision Making Framework

Table 5-1: ALARP Decision Making based upon Level of Uncertainty

Decision Type	Description	Decision Making Tools
A	Risks classified as a Decision Type A are well-understood and established practice	<p>Good Practice Control Measures are considered to be:</p> <p>Legislation, codes and standards: Identifies the requirements of legislation, codes and standards that are to be complied with for the activity.</p> <p>Good Industry Practice: Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards.</p> <p>Professional Judgement: Uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the ‘Hierarchy of Controls’ philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks, is applied.</p>

Decision Type	Description	Decision Making Tools
B	Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns.	Risk-based tools, such as cost based analysis or modelling: Assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.
C	Risks classified as a Decision Type C will typically involve sufficient complexity, high potential impact, uncertainty or stakeholder interest	Precautionary Approach: OGUK (2014) state that if the assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then a precautionary approach to hazard management is needed. A precautionary approach will mean that uncertain analysis is replaced by conservative assumptions that will result in control measures being more likely to be implemented.

**5.7.2 Control Measure identification**

Control measures were identified to eliminate each aspect or otherwise minimise the risks and impacts to ALARP. The process of identifying control measures involved:


- Identifying a risk control;
- Assessing the risk control;
- Deciding whether residual risk levels are tolerable;
- If not tolerable, identifying a new risk control; and
- Assessing the effectiveness of that control.

The Santos hierarchy of control is illustrated in Table 5-2. This process moves from risk elimination through to protection, in descending order of effectiveness, until a control measure(s) can be identified.

Performance outcomes, standards and measurement criteria are established in line with the control measure(s). Terms used for measuring the environmental performance for each hazard are defined as:

- *Control measure* – a system, an item of equipment, a person or a procedure that is used as a basis for managing environmental impacts and risks.
- *Environmental outcome* – the outcomes that are identified by the interest holder to ensure environmental protection. These outcomes should relate to each risk and impact identified during the ERA process, and be consistent with commitments and targets presented in the Corporate Environment Policy.
- *Performance standard* – performance required of a control measure.
- *Measurement criteria* – defines how environmental performance will be measured and determine whether the outcomes and standards have been met.

**Table 5-2 Santos Hierarchy of Control**

Control	Effectiveness	Example
Eliminate		Removal of the risk. Refuelling of vehicles at the terminal eliminates the risks of an onsite refuelling.
Substitute		Change the risk for a lower one. The use of low-toxicity chemicals that perform the same task as a more toxic additive.
Engineering		Engineer out the risk. The use of oil traps and interceptor drains to reduce the contaminant discharged.
Isolation		Isolate people or the environment from the risk. The use of bunding for containment of bulk liquid materials.
Administrative		Provide instructions or training to people to lower the risk. The use of Job Hazard Analysis to assess and minimise the environmental risks of an activity.
Protective		Use of protective equipment. Containment and recovery of spilt hydrocarbons.

### 5.8 Determination of Severity of Consequence

The potential level of impact (consequence) was assessed and assigned, in line with potential hazards and receptors, using the ‘Santos Environmental Consequence Classification’ (Table 5-3) from the Santos Operational Risk Matrix. The consequence level for each hazard is documented in the risk assessment tables in Section 6.

**Table 5-3 Santos Environmental Consequence Classification**

Level	Environment
VI	Regional and long-term impact on an area of significant environmental value. Destruction of an important population of plants and animals with recognised conservation value. Complete remediation impossible.
V	Destruction of an important population of plants or animals or of an area of significant environmental value. Complete remediation not practical or possible.
IV	Extensive and medium term or localised and long-term impact to an area, plants or animals of recognised environmental value. Remediation possible but may be difficult or expensive.

Level	Environment
III	Localised and medium term or extensive and short-term impact to areas, plants or animals of significant environmental value. Remediation may be difficult or expensive.
II	Localised and short-term impact to an area, plants or animals of environmental value. Readily treated.
I	Localised and short term environmental or community impact – readily dealt with.

Definitions	
Duration of potential impact	Extent of impact
Short term: Days or weeks	Localised: Within the project area
Medium Term: Less than 12 months	Extensive: Within the permit area
Long Term: Greater than 12 months	Regional: Outside of the permit area

### 5.9 Determination of Likelihood

Likelihood relates to the potential for a consequence to occur. This includes the likelihood of an event occurring and the subsequent potential consequence. This is defined using the Santos Likelihood Descriptors (Table 5-4) from the Santos Operational Risk Matrix.

**Table 5-4 Santos Likelihood Descriptors**

Level	Criteria
Almost Certain	f Occurs in almost all circumstances or could occur within days to weeks
Likely	e Occurs in most circumstances or could occur within weeks to months
Occasional	d Has occurred before in Santos or could occur within months to years
Possible	c Has occurred before in the industry or could occur within the next few years
Unlikely	b Has occurred elsewhere or could occur within decades
Remote	a Requires exceptional circumstances and is unlikely even in the long term or only occurs as a “100-year event”

### 5.10 Residual Risk Ranking

Risk is expressed in terms of a combination of the consequence of an impact and the likelihood of the impact occurring. Santos uses a Corporate Risk Matrix (Table 5-5) to plot the consequence and likelihood to determine the level of risk.



Once the level of risk is determined Santos uses a Risk Significance Rating (Table 5-6) to determine the magnitude of the risk and if further action is required to reduce the level of risk using the process described in Section 3.6.

**Table 5-5 Santos Risk Matrix**

	I	II	III	IV	V	VI
f	2	3	4	5	6	5
e	2	3	4	4	5	6
d	2	2	3	4	4	6
c	1	2	2	3	4	5
b	1	1	2	2	3	4
a	1	1	1	2	3	3

**Table 5-6 Santos Risk Significance Rating**

RISK LEVEL	MITIGATION / INVESTIGATION FOCUS (ADD ADDITIONAL BUSINESS UNIT SPECIFIC REQUIREMENTS WHERE REQUIRED)
5	<ul style="list-style-type: none"> <li>- Intolerable risk level</li> <li>- Following verification of the residual risk at level 5, activity must stop</li> <li>- Activity cannot recommence until controls implemented to reduce residual risk to level 4 or lower</li> <li>- Dedicated multi-disciplinary incident investigation team</li> <li>- Management involvement in the investigation</li> </ul>
4	<ul style="list-style-type: none"> <li>- Assess risk to determine if ALARP</li> <li>- If ALARP, activities related to maintenance of controls/ barriers prioritised &amp; managed</li> <li>- If not ALARP, improve existing controls and/or implement new control/s</li> <li>- Dedicated multi-disciplinary incident investigation team</li> </ul>
3	<ul style="list-style-type: none"> <li>- Assess risk to determine if ALARP</li> <li>- If ALARP, activities related to maintenance of controls/ barriers prioritised &amp; managed</li> <li>- If not ALARP, improve existing controls and/or implement new control/s</li> <li>- Full incident investigation</li> </ul>
2	<ul style="list-style-type: none"> <li>- Assess risk to determine if ALARP</li> <li>- If ALARP, activities related to maintenance of controls/ barriers prioritised &amp; managed</li> <li>- If not ALARP, improve existing controls and/or implement new control/s</li> <li>- Incident investigations using simple tools</li> </ul>
1	<ul style="list-style-type: none"> <li>- Managed as stipulated by the related work processes</li> <li>- No incident investigation required</li> </ul>

**5.11 Determination of Impact and Risk Acceptability**

The model Santos used for determining acceptance of residual risk is detailed in Figure 5-2. In summary:

- A Level 5 residual risk is intolerable and must not be accepted or approved by Management.



- A Level 2 – 4 residual risk is acceptable provided that ALARP has been achieved and demonstrated.
- A level 1 residual risk is 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 1 (and ALARP Decision Type A selected and good practice control measures applied), or
- The residual risk is determined between 2 and 4 and ALARP can be demonstrated; and
- The following have been met:
  - Principles of ESD
  - Legal and other requirements
  - Santos policies and standards
  - Stakeholder expectations

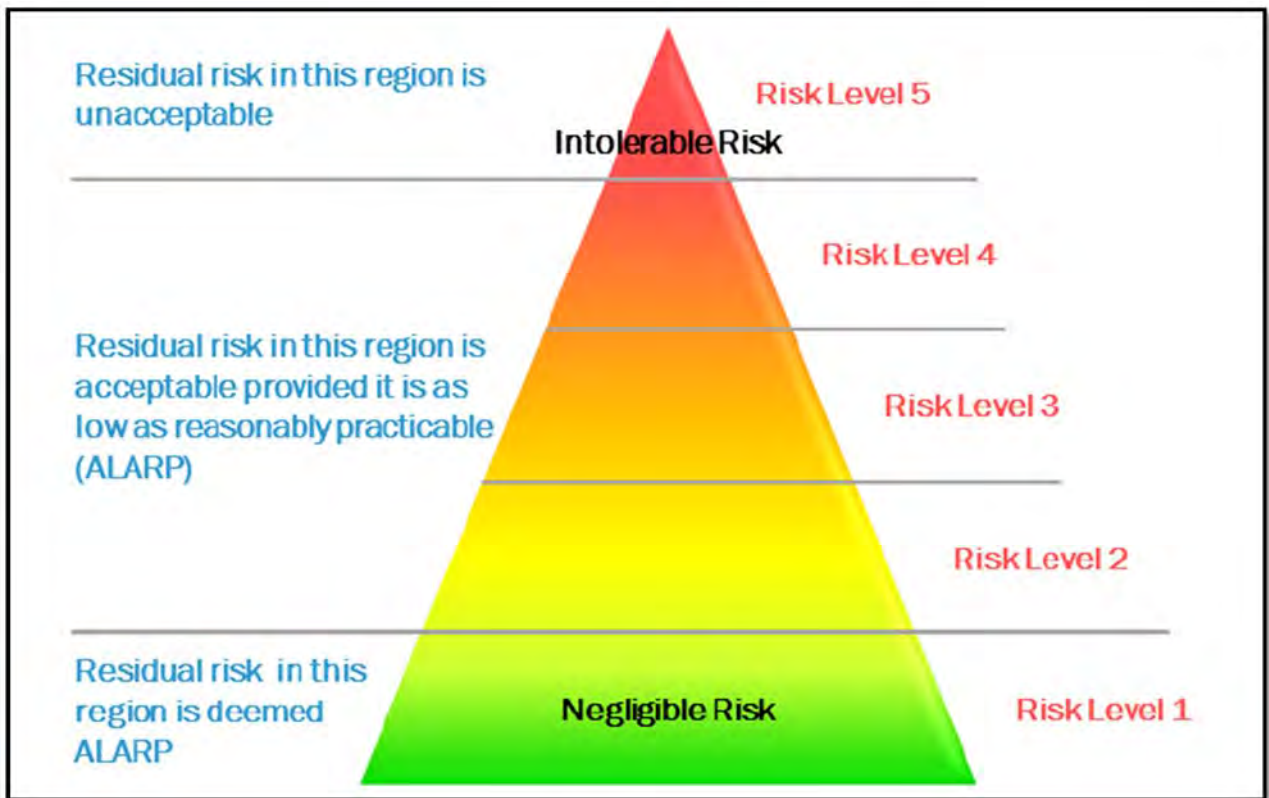


Figure 5-2 Santos Residual Risk Acceptance Model

## 6.0 ENVIRONMENTAL RISK ASSESSMENT

### 6.1 Section overview

A risk assessment was conducted and considered for planned and unplanned aspects for the proposed activity (as described in Chapter 5.0). The planned and potential interactions between the described activity, the aspects triggered and the described environment represent a source of risk (or impact) which has potential to affect the described environment.

### 6.2 Planned activities

The aspects which are likely to be triggered for the key activities proposed to be undertaken for the water bore monitoring program are:

- Physical disturbance
- Atmospheric Emissions
- Noise

To identify and assess the impacts of the activities, the potential for an aspect to impact the receptors present has been undertaken, and a summary of this provided in Table 6-1.

**Table 6-1 Summary Table Aspects and Receptors for Planned Activities**

Aspect	Receptor	Potential impacts or risk
Physical Disturbance	Native fauna	Disturbance to native fauna
	Baseline water conditions	Disturbance to natural drainage patterns
	Soil	Erosion of exposed soil surfaces
	Culturally sensitive sites	Disturbance to culturally sensitive site
	Livestock, pastoral infrastructure and landholders	Disturbance to livestock, pastoral infrastructure and landholders
Atmospheric Emissions	Air quality	Reduction in air quality
	Native flora	Dust smothering native vegetation
	Native fauna	Disruption to native fauna
	Livestock, pastoral infrastructure and landholders	Loss of amenity
Noise	Native Fauna	Disturbance to native fauna
	Livestock, pastoral infrastructure and landholders	Loss of amenity

#### 6.2.1 Physical Disturbance

Physical disturbance will occur during the preparation of the water monitoring bore lease pad. This will be limited to the project area described in Section 3.0 Figure 3-2. Access to the water

monitoring bore lease pads will be via existing landholder access in good trafficable condition and no upgrades are required.

No clearing is required and the use of borrow pits is not required as no fill or gravel is required for the minimal works.

### ***Sensitive Environmental Receptors with the Potential to Occur within the Project Footprint***

Based upon the receptors identified in Section 4.0, those known to be impacted by physical disturbance are shown in Table 6-2.

**Table 6-2 Physical Disturbance Receptor risks and impacts**

Receptor	Potential Impact
Native fauna	Disturbance to native fauna
Baseline water conditions	Disturbance to natural drainage patterns
Soil	Damage to soil (compaction) and exposure
Cultural heritage	Disturbance to culturally sensitive sites
Livestock, pastoral infrastructure and landholders	Disturbance to livestock, pastoral infrastructure and landholders

### ***Evaluation of Environmental Impacts***

The installation works for the water monitoring bores will occur during November 2018. The physical disturbance is expected to occur along access tracks and during the preparation of the water monitoring bore lease.

#### ***Native Flora***

Other than some perennial grasses and shrubs it is unlikely that vegetation will be disturbed during the preparation of the water monitoring bore lease pad. No vegetation clearing is required for the access track. The maximum estimated extent of disturbance associated with the water monitoring bore lease pad is 0.785 ha. This disturbance is not expected to result in localised impacts to native flora.

#### ***Native Fauna***

The fauna habitat values of the lease pad location are minimal (see Figure 3-3). The project activities are unlikely to cause disturbance to fauna habitats through vegetation clearing.

The level of disturbance is extremely small, in the context of the availability of better habitat in the immediate vicinity of the project footprint, and as such it will result in little to no localised impacts to native fauna.

#### ***Baseline Water Conditions***

The clearance of vegetation has the potential to alter the hydrogeological conditions by increasing the rate and volume of recharge water entering the water table. Given that the area already has a low level of vegetation coverage and the area of actual disturbance within the project area is relatively small this effect will be negligible.

Project activities may potentially result in the alteration of surface waters through the placement of roads and water monitoring bores. The project is located at the top of the catchment. The surface waters in the vicinity of the project are limited to first, second and third order ephemeral streams and subject to short flow duration and high turbidity. Given the small area of disturbance and the lack of permanent surface waters, impacts to surface water flow is not likely to be significant.

#### *Soil*

Project activities have the potential to result in localised soil compaction through vehicle movements and storage of equipment. Compaction of soil has the potential to negatively affect plant root growth, soil moisture potential, soil quality, vegetation establishment, surface and subsurface drainage, runoff and soil erosion. Many factors will affect the potential for soil to compact including the soil type and characteristics. Soil types within the project area are mostly sandy, and will potentially compact particularly if wet at the time of compaction.

Access to the water monitoring bore lease pads will be preferentially located on existing tracks and seismic lines. Water bore drilling rigs will be all-terrain vehicles, reducing the need to undertake major physical disturbances to upgrade access. Once the water monitoring bores are in place the low level of traffic associated with monitoring events will reduce the potential for impact to negligible

#### *Cultural heritage*

Project activities have the potential to disturb culturally sensitive sites.

The project footprint is required to be cleared for works prior to the commencement of activities by the NLC and then certified by AAPA. The NLC has issued Santos with a NLC SSCC detailing Exclusion Zones, Restricted Work Areas and conditions associated with working within the project footprint.

**\*\*Text Redacted\*\***.

A search of the NT Heritage Register indicates that there are no recorded NT listed heritage items or places are present in the project footprint.

It is possible that disturbance to culturally sensitive area could occur and impacts would be long-term as remediation would be difficult.

#### *Landholders*

The project footprint is located on a cattle grazing property (Tanumbirini Station). The closest water monitoring bore is located approximately 4km from the homestead. The water monitoring bore locations were selected ensuring normal grazing operations could continue. The presence and movement of water bore drilling rigs, other vehicles and personnel has the potential to disturb the activities and amenity of the Tanumbirini Station landholder and potentially other surrounding landholders in the area. Landholder consent and consultation is required prior to activities to ensure that impacts are managed to acceptable levels and as agreed. On 22 October 2018 the Land Access and Compensation Agreement between Santos QNT Pty Ltd and Thames Pastoral

Company Pty Ltd was revised to accommodate the water bore drilling program. A redacted copy of this agreement is provided in Appendix 4.

Table 6-3 provides a summary assessment of the potential risk of unmitigated impacts to environmental receptors due to physical disturbance.

**Table 6-3 Physical Disturbance Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Native fauna	Disturbance to native fauna and loss of habitat	Unlikely	I	1	NT Government
Baseline water conditions	Disturbance to natural drainage patterns	Possible	II	2	NT Government
Soil	Damage to soil (compaction) and exposure	Unlikely	II	1	Landholders
Cultural heritage	Disturbance or damage to culturally sensitive site	Unlikely	IV	3	Aboriginal groups
Landholders	Disturbance to livestock, pastoral infrastructure and landholders	Possible	I	1	Landholders

**Control Measures**

To manage physical disturbance and mitigate potential risks and impacts, the control measures outlined in Table 6-4 will be implemented.

**Table 6-4 Controls to reduce risk and impacts of Physical Disturbance**

Receptor	Control
General controls	All personnel are given environmental and cultural heritage inductions prior to commencing work. Inductions for all employees and contractors cover pastoral, conservation, legislation and infrastructure issues.
	Activities to be planned to minimise new land disturbance by utilising previous disturbed areas or existing tracks (where possible), and through operational practices including weaving
Native fauna	Clearing of vegetation for track upgrades will be prohibited.
	Flora rootstock will be left intact to promote regeneration.
	Steep terrain will be avoided (where possible).
	No Hollow timber/trees will be cleared

Receptor		Control
Baseline conditions	water	Alteration of natural drainage contours or lines will be avoided
Soil		An all-terrain water bore drill rig will be used.
		Alteration of natural drainage contours or lines will be avoided and/or bypass structures installed to minimise obstruction to flow
		Erosion and sediment control structures (e.g. berms, sediment fences) to be installed and maintained where necessary.
		Inversion of the soil profile will be minimised where possible
Cultural heritage		Disturbance is restricted to areas for which NLC clearance has been provided.
		Disturbance is restricted to subject land as detailed in the AAPA Authority Certificate.
		Known sites of sacred or cultural significance are identified and avoided.
		Any new sites identified during the activity will be reported to the Santos Cultural Heritage Team and avoided.
		Maintain GIS database of project footprint and cultural heritage sites including details of any works conditions.
Landholders		Relevant landowners and occupiers and relevant third-party tenement holders are notified prior to activity.
		All gates are left in the condition in which they were found (i.e. open / closed).
		Damage to station tracks is avoided and reported if does occur.
		Unauthorised offline driving is prohibited for all project personnel.
		When necessary, all fences are restored to satisfaction of landowner / managers.
		System is in place for logging landholder complaints to ensure that issues are addressed as appropriate.

**Post treatment risk**

Given the location of the project and the relatively small size physical disturbance, together with the proposed controls, the potential for physical disturbance is reduced to an acceptable level. With the application of controls described in Table 6-5, the overall risk ranking is Level 2 (Table 6-5).

**ALARP Discussion**

The impacts and risks associated with physical disturbance is considered a decision ‘Type A’, meaning that they are well-understood and that there are established practices in place to



manage these risks. With implementation of the control measures, it is considered that the risks and impacts of physical disturbance have been reduced to ALARP.

***Statement of acceptability***

The residual risk for physical disturbance is Level 2. Using Santos' model for acceptance, this is considered to be acceptable providing that ALARP has been achieved and is demonstrated.

**Table 6-5 Physical Disturbance Residual Risk Ranking**

Receptor	Risk or Impact	Pre-treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Native fauna	Disturbance to native fauna and loss of habitat	1	Minimise disturbance to native fauna	Unlikely	I	1	Type A	Demonstrated	Y
Baseline water conditions	Disturbance to natural drainage patterns	2	Minimise disturbance to drainage patterns and avoid contamination of surface waters and shallow groundwater resources	Unlikely	II	1	Type A	Demonstrated	Y
Soil	Damage to soil (compaction) and exposure	1	Minimise disturbance to and contamination of soil resources.	Unlikely	II	1	Type A	Demonstrated	Y
Cultural heritage	Disturbance or damage to culturally sensitive site	3	Avoid disturbance to sites of cultural, sacred and heritage significance	Unlikely	IV	2	Type A	Demonstrated	Y
Landholders	Disturbance to livestock, pastoral infrastructure and landholders	1	Minimise disturbance to livestock, pastoral infrastructure and landholders	Possible	I	1	Type A	Demonstrated	Y

## 6.2.2 Atmospheric Emissions

Dust is generated naturally throughout the region, due to the low total rainfall, long dry seasons and the fine sediment particle size. The region has experienced previous dust generation for exploration and pastoral activities. Additional dust emissions may occur during earthworks or as a result of exposed soil surfaces and the movement of vehicles and machinery during operations. Any dust generated is expected to quickly disperse in high winds or settle quickly close to the point source. The degree of exposure is considered to be less than would occur in a dust storm under dry, windy conditions, or adjacent a dirt road with regular vehicular traffic.

Transportation activities including mobilisation and demobilisation, to the project and vehicle movements within the project footprint will result in dust emissions. Vehicle exhaust emissions will occur during water bore drilling and monitoring events.

### ***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be impacted by transportation activities are shown in Table 6-6.

**Table 6-6 Atmospheric Emissions Receptor risks and impacts**

Receptor	Potential Impact
Air quality	Reduction in air quality
Native flora	Dust smothering native vegetation
Native fauna	Disruption to native fauna
Livestock, pastoral infrastructure and landholders	Loss of amenity

### ***Evaluation of Environmental Impacts***

#### *Air quality*

Vehicles will emit air emissions. The emissions will be limited to the water bore drilling program in November 2018 and future groundwater monitoring events. Dust will be generated through vehicles travelling on unsealed roads and any disturbance that is required to prepare the water monitoring bore lease pads. This activity is limited in duration (short-term) and impacts are restricted to the air quality in the immediate vicinity (localised).

#### *Native Flora*

Dust generated by vehicle movements will initially be airborne; however, particles will quickly settle in the surrounding area as dust particles settle out of the air column. This has the potential to cover flora and can potentially decrease vegetation growth by smothering leaves.

The composition of dust particles is dependent on the nature of the source material. Topsoil is fairly homogenous within the project footprint; therefore, negligible variation is expected in the dust generated between different parts of the project footprint. This activity is limited in duration and impacts to native flora are expected to be negligible.

*Native fauna*

Dust may disrupt fauna in the immediate vicinity of the project site. Fauna may be discouraged to forage on vegetation impacted by dust. These impacts are likely to be isolated to the immediate areas surrounding the project footprint where dust settles or be temporary until dust disperses. This activity is limited in duration and impacts to native fauna is expected to be negligible.

*Landholders*

Landholders may be impacted by dust generation as a result of reduced amenity or through health impacts. Dust is generated naturally throughout the region due to the low total rainfall and fine sediment size, therefore the sensitivity to dust from landholders is likely to be low. In addition the project footprint is remote therefore the likelihood of landholders in the vicinity to be impacted by any temporary reduction in amenity is low.

It is expected that cattle could leave an area if reduced air quality is temporarily a nuisance. However, impacts are limited in duration and any temporary nuisance to cattle is expected to be negligible.

Table 6-7 provides a summary assessment of the potential risk of unmitigated impacts to environmental receptors due to atmospheric emissions.

**Table 6-7 Atmospheric Emission Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Air quality	Reduction in air quality	Likely	II	3	Landholders
Native flora	Smothering of undisturbed vegetation	Possible	II	2	NT Government
Native fauna	Disturbance to fauna	Possible	II	2	Landholders
Livestock, pastoral infrastructure and landholders	Loss of amenity	Possible	II	2	Landholders

**Control Measures**

To manage and mitigate the potential risks and impacts associated with atmospheric emissions, the control measures outlined in Table 6-8 will be implemented.

**Table 6-8 Controls to reduce risk and impacts of atmospheric emissions**

Receptor	Control
All	Personnel are given environmental and cultural heritage inductions prior to commencing work.
	Where possible, existing tracks, roads or seismic lines will be used for access.

Receptor	Control
	Off track driving is prohibited – no bush bashing or short cuts are permitted.
	Speeds on unsealed roads will be limited – max 80 km/hr on unsealed roads, 40 km/hr on water bore access tracks and seismic lines.
	Any remediation work should be undertaken upon completion of all activities.

**Post treatment risk**

Given the location of the project and the relatively small nature of operations together with the proposed controls the potential for atmospheric emissions is reduced to an acceptable level.

With the application of controls described in Table 6-8, the likelihood of potential impacts is reduced to ‘possible’ and the consequence ranking assigned a ‘level 1’, resulting in an overall risk ranking of 1 (Table 6-9).

**ALARP Discussion**

The impacts and risks associated with noise is considered a decision ‘Type A’, meaning that they are well-understood and that there are established practices in place to manage these risks. With implementation of the control measures, it is considered that the risks and impacts of atmospheric emissions have been reduced to ALARP.

**Statement of acceptability**

The residual risk for noise is 1. Using Santos’ model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.

**Table 6-9 Atmospheric Emissions Residual Risk Ranking**

Receptor	Risk or Impact	Pre-treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Air quality	Reduction in air quality	3	Minimise emissions to air	Possible	I	1	Type A	Demonstrated	Y
Native flora	Smothering of undisturbed vegetation	2	Minimise disturbance to native vegetation	Possible	I	1	Type A	Demonstrated	Y
Native Fauna	Disturbance to fauna	2	Minimise disturbance to native fauna	Possible	I	1	Type A	Demonstrated	Y
Landholders	Loss of amenity	2	Minimise the visual impact of operations	Possible	I	1	Type A	Demonstrated	Y



### 6.2.3 Noise

The region has experienced previous noise disturbance for exploration and pastoral activities. Noise emissions will occur from vehicle movements and the drilling of water monitoring bores.

#### ***Sensitive Environmental Receptors with the Potential to Occur within the Project Footprint***

Based upon the receptors identified in Section 4.0, those known to be impacted by noise are shown in Table 6-10.

**Table 6-10 Noise Receptor risks and impacts**

Receptor	Potential Impact
Native Fauna	Disturbance to native fauna
Livestock, pastoral infrastructure and landholders	Loss of amenity Disturbance to livestock

#### ***Evaluation of Environmental Impacts***

The noise generated from the water monitoring bore program will be associated with the drilling of the water monitoring bores, vehicle and equipment movements and the ongoing vehicle access required during the groundwater monitoring events. The water monitoring bore drilling program is expected to be complete by November 2018.

##### *Native Fauna*

The project activities will generate noise that is likely to cause some level of fauna disturbance.

Noise from the activities are likely to cause temporary localised fauna behaviour changes adjacent to the water monitoring bore lease pad. The drilling activity is limited in duration and impacts to native fauna is expected to be negligible. Therefore, potential impacts from noise during the day are not expected to be significant.

##### *Landholders*

The project footprint is located at Tanumbirini Station. Santos will have agreements in place with landholders and maintain ongoing communications during operations. Based on previous operational experience in the area, impacts to landowners (reduced amenity) due to noise are unlikely as any noise emissions are localised and short term in nature and are generally remote from any homesteads.

##### *Livestock*

It is likely that livestock will be found in close proximity to the water monitoring bore locations, however, it is anticipated that they will move away from the area should they be temporarily disturbed by noise. Any impacts are likely to be localised and behavioural only, and short term.

Table 6-11 provides a summary assessment of the potential risk of unmitigated impacts to environmental receptors due to noise.

**Table 6-11 Noise Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Native Fauna	Disturbance to fauna	Occasional	I	2	NT Government
Livestock, pastoral infrastructure and landholders	Loss of amenity	Occasional	I	2	Landholders
	Disturbance to livestock	Likely	I	2	Landholders

**Control Measures**

To manage and mitigate the potential risks and impacts associated with noise emissions, the control measures outlined in Table 6-12 will be implemented.

**Table 6-12 Controls to reduce risk and impacts of Noise Emissions**

Receptor	Control
All	Personnel are given environmental and cultural heritage inductions prior to commencing work.
	Relevant landholders and occupiers are consulted with respect to water bore locations.
	Landholders are provided updates on progress throughout the project (both water monitoring bore drilling and groundwater monitoring events).
Landholders	Maintain communications during operations with relevant landholders.
	Water bore drilling will only occur during daylight hours.

**Post treatment risk**

Given the location of the project and the relatively small nature of operations, together with the proposed controls the potential for noise is reduced to an acceptable level.

With the application of controls described in Table 6-12, the likelihood of potential impacts is reduced to ‘possible’ and the consequence ranking assigned a ‘level 1’, resulting in an overall risk ranking of 1 (Table 6-13).

**ALARP Discussion**

The impacts and risks associated with noise is considered a decision ‘Type A’, meaning that they are well-understood and that there are established practices in place to manage these risks. With implementation of the control measures, it is considered that the risks and impacts of noise have been reduced to ALARP.

**Statement of acceptability**

The residual risk for noise is 1. Using Santos’ model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.

**Table 6-13 Noise Residual Risk Ranking**

Receptor	Risk or Impact	Pre-treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Fauna	Disturbance to native fauna	2	Minimise disturbance to native fauna	Possible	I	1	Type A	Demonstrated	Y
Livestock, infrastructure and landholders	Loss of amenity	2	Minimise disturbance to landholders	Possible	I	1	Type A	Demonstrated	Y
Livestock, infrastructure and landholders	Disturbance to livestock	2	Minimise disturbance to livestock	Possible	I	1	Type A	Demonstrated	Y

### 6.3 Unplanned activities

The aspects that are likely to be triggered for the key activities undertaken for water monitoring bore program are:

- Fauna Interaction
- Erosion
- Introduced pests/pathogens
- Fire
- Disturbance to Stakeholders
- Waste and Chemical Spills and Leaks

To identify and assess the impacts of the activities, the potential for an aspect to impact the receptors present has been undertaken, and a summary of this provided in Table 6-27.

**Table 6-14 Summary Table Aspects and Receptors from Unplanned Activities**

Aspect	Receptor	Potential impacts or risk
Fauna Interaction	Native fauna	Disturbance, injury or death to native fauna
	Livestock, pastoral infrastructure and landholders	Disturbance, injury or death to livestock
Erosion	Soils	Soil erosion due to ground disturbance
	Baseline water conditions	Increased runoff Increased sediment loads Disturbance to natural drainage patterns
	Native flora and fauna	Direct loss of vegetation/fauna habitat
	Culturally sensitive sites	Disturbance to culturally sensitive sites
	Livestock, pastoral infrastructure and landholders	Disturbance to landholders
Introduced pests/pathogens	Native flora	Introduction and or spread of weeds, pest plants, animals and pathogens.
	Native fauna	Introduction and or spread of weeds, pest plants, animals and pathogens.
	Livestock, pastoral infrastructure and landholders	Disturbance to Livestock
Fire	Native fauna	Disturbance, injury or death to native fauna
	Native flora	Loss of vegetation
	Livestock, pastoral infrastructure and landholders	Disturbance, injury or death to livestock Damage / loss to dwellings, infrastructure

Aspect	Receptor	Potential impacts or risk
Disturbance to Stakeholders	Livestock, pastoral infrastructure and landholders	Unplanned interaction with or disturbance to other land users
Waste and Chemical Spills and Leaks	Surface Water	Reduction in surface water quality
	Groundwater	Reduction in groundwater quality
	Soil	Reduction in soil quality
	Native fauna	Attraction to inappropriately stored waste

**6.3.1 Fauna Interaction**

Vehicle collision with fauna / livestock may occur all activities associated with the project where vehicles are required. The area where vehicle collision may occur could be anywhere vehicles are required to access as a part of the activity. For this EMP, this will be limited to the project area shown in Figure 3-2.

***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be potentially impacted by fauna interaction are detailed in Table 6-15

**Table 6-15 Fauna Interaction Receptor risks and impacts**

Receptor	Potential Impact
Native fauna	Disturbance, injury or death to native fauna
Livestock, pastoral infrastructure and landholders	Disturbance, injury or death to livestock

***Evaluation of Environmental Impacts***

Vehicle collision with fauna / livestock could occur as vehicles move around the project footprint and mobilising and demobilising to and from the project footprint. Any impacts to fauna and livestock will be on an individual (i.e. not population) scale.

*Native Fauna*

Native fauna is typical of inland Australia, and likely to include small, fast moving species of mammal and reptile. Fauna are likely to be most active during dawn and dusk, when temperatures are lower, with many species adapted to a nocturnal lifestyle; therefore, will not be sensitive to the potential impacts associated with increased vehicle traffic mostly during daylight hours.

*Livestock*

In comparison to native fauna, livestock are more sensitive to vehicle collision. Livestock animals on Tanumbirini grazers; larger and slower than native animals and more likely to be mobile during the day. It is likely, that livestock will be found mostly gathered in herds, allowing drivers to be fully aware of their presence long before potential for a collision is realised. Vehicles will also be restricted to defined routes / locations, and only low levels of traffic are expected.

Table 6-16 provides a summary assessment of the potential risk ranking to environmental receptors due to fauna interaction.

**Table 6-16 Fauna Interaction Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Native fauna	Disturbance, injury or death to native fauna	Likely	I	2	NT Government

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Livestock, pastoral infrastructure and landholders	Disturbance, injury or death to livestock	Likely	II	2	Landholders

**Control Measures**

To prevent project-attributable interaction with native fauna or livestock and mitigate the potential risks and impacts the control measures outlined in Table 6-17 will be implemented.

**Table 6-17 Controls to reduce risk and impacts of Fauna Interaction**

Receptor	Control
All	Driving will only occur during daylight hours
	Personnel are given environmental and cultural heritage inductions prior to commencing work.
	Off track driving is banned – no bush bashing or short cuts are permitted.
	Relevant landowners and occupiers are notified prior undertaking activities.
	All gates are left in the condition in which they were found (i.e. open / closed).
	When necessary, all fences are restored to satisfaction of landowner / managers.
	Speed will be limited along lines to 40km/hr and 80km/hr on other unsealed roads.
	All vehicle routes have speed limits set which must be adhered to.

**Post treatment risk**

Given the generally low traffic volumes expected, together with the proposed controls, the potential for fauna interaction is reduced to an acceptable level. With the application of controls described in Table 6-17, the likelihood level of potential impacts is reduced to ‘likely’ and the consequence ranking assigned a ‘level 1’, resulting in an overall risk ranking of 2.

**ALARP discussion**

The impacts and risks associated with fauna interaction are considered to be a decision Type A, meaning that they are well-understood and that there are established practices in place to manage these risks. With implementation of the control measures, it is considered that the risks and impacts from fauna interaction have been reduced to ALARP.

**Statement of acceptability**

The residual risk for noise is 1. Using Santos’ model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.



**Table 6-18 Fauna Interaction Residual Risk Ranking**

Receptor	Risk or Impact	Pre-Treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Native fauna	Disturbance, injury or death to native fauna	2	Minimise disturbance to native fauna	Possible	I	1	Type A	Demonstrated	Y
Livestock, infrastructure and landholders	Disturbance, injury or death to livestock	2	Minimise disturbance to livestock, pastoral infrastructure and landholders	Possible	I	1	Type A	Demonstrated	Y

### 6.3.2 Erosion

The physical disturbance associated water monitoring bores may result in erosion. This will be limited to the project area described in Section 3.0 or areas previously disturbed as a part of activities in 2014. Erosion may occur following disturbance to soil associated with access track preparation and the construction of water monitoring bore lease pads.

While the area of potential erosion is difficult to predict, the area of disturbance is shown on Figure 3-2.

#### ***Sensitive Environmental Receptors with the Potential to Occur within the Project Area***

The landscape of northern and central Australia is ancient and highly weathered and the soil types are prone to severe erosion. Soil erosion can not only disrupt the progress of the activity and add maintenance costs, but can remove fertile topsoils impacting on flora and fauna, and cause damage to pastoral infrastructure and environmentally and culturally sensitive sites.

Based upon the receptors identified in Section 4.0, those known to be impacted by erosion are shown in Table 6-19.

**Table 6-19 Erosion Receptor risks and impacts**

Receptor	Potential Impact
Soils	Soil erosion due to ground disturbance
Baseline water conditions	Increased runoff Increased sediment loads Disturbance to natural drainage patterns
Native flora and fauna	Direct loss of vegetation/fauna habitat
Culturally sensitive sites	Disturbance to culturally sensitive sites
Livestock, pastoral infrastructure and landholders	Disturbance to landholders

#### ***Evaluation of Environmental Impacts***

##### *Soils*

The soils of project area are susceptible to erosion given that the region experiences long dry periods followed by intense rains. In this environment, the soils become disturbed and once disturbed can be easily eroded.

The soil systems in the project area vary, however the majority of the soils present are described as sandy and earth soils or shallow soils with rock outcrop. When disturbed, even a small amount of water can cause erosion resulting in substantial volumes of soil potentially being lost. This can result in increasing sediment loads and in a localised loss of vegetation and habitat, as well as a potential for disturbance to culturally sensitive sites and landholders should such areas be within the area impacted by the potential erosion.

*Baseline water conditions*

Ground disturbance associated with the project has the potential to result in increased runoff, increased sediment loads and the disturbance of natural drainage patterns.

All surface waters near the project area including the lower stream order drainage lines are ephemeral and subject to short flow duration and high turbidity. Given the lack of permanent surface waters and turbid nature of surface waters during times of flood, impacts to surface waters as a result of erosion is not likely to be significant, however the surface water flows may promote increased erosion, adding to the sediment load of already turbid waters.

*Native flora and fauna*

Erosion has the potential to result in the loss of important top soils, and direct loss of vegetation and habitat. The area of disturbance is however relatively small, and the project area will avoid areas close to sensitive vegetation and habitat. Impacts are therefore not likely to be significant.

*Culturally sensitive sites*

Culturally sensitive sites will be avoided by the water monitoring bore project. However, impacts from erosion can result offsite of the project area if unmanaged and there is therefore a potential for impacts to culturally sensitive sites in adjacent areas. However the disturbance is over a relatively small area and the activity will be managed to reduce erosion risk, any impacts to culturally sensitive sites is a very unlikely scenario.

*Livestock, pastoral infrastructure and landholders*

As with the cultural sites, there is the potential that impacts of erosion could occur offsite of the project area if unmanaged. Landholder roads and other infrastructure (e.g. fencing) could be at risk from erosion due to project activities. Given however that the disturbance is over a relatively small area and the activity will be managed to reduce erosion risk, it is unlikely to result in significant impact.

The region has experienced previous disturbance from exploration and pastoral activities. While this does not present a significant risk or impact, there remains a potential for erosion and as such measures are to be taken to prevent and mitigate impacts.

The pre-treatment risk ranking is provided in Table 6-20.

**Table 6-20 Erosion pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Soil	Soil erosion due to ground disturbance	Occasional	III	3	NT Government Landholders
Baseline water conditions	Increased runoff and erosion	Occasional	III	3	NT Government
	Increased sediment loads	Possible	III	2	NT Government
	Disturbance to natural drainage patterns	Unlikely	III	2	Landholders

Native flora	Direct loss of vegetation	Possible	III	2	NT Government
Cultural heritage	Disturbance to culturally sensitive sites	Unlikely	III	2	Aboriginal groups
Livestock, infrastructure and landholders	Disturbance to pastoral and landholders	Possible	III	2	Landholders

**Control Measures**

Each type of erosion may require differing management methods. An effective erosion control program requires planning and controlled implementation for the types of erosion predicted and observed as a result of the activity. The use of ESCPs is recommended to set out erosion and sediment control methods, strategies and works appropriate to specific land use and developments.

The ESCP will be developed to be usable in the field as an instruction manual for personnel, providing clear directions and quick reference to methodology or standard drawings of erosion and sediment control structures.

In addition to prevent soil erosion and mitigate the potential risks and impacts the control measures outlined in Table 6-21 will be implemented

**Table 6-21 Controls to reduce risk and impacts of Erosion**

Receptor	Control
All	Disturbance is restricted to areas for which consent has been provided.
	No clearing of vegetation for access .
	Due to the instability and erosion potential when disturbed, the steeper slopes and escarpments of tableland land systems are avoided.
	Creek bank vegetation is left intact.
	Unavoidable compaction in areas other than those susceptible to erosion, will be ripped on completion of work.
	Any remediation work should be undertaken upon completion of all activities.
	Unauthorised offline driving is prohibited for all project personnel.
	Operations are shut down during 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 re-visited to ensure controls are still appropriate to manage risk to ALARP.

***Post treatment risk***

Given the relatively small area of disturbance, the use of all-terrain vehicles limiting the need for road upgrades and with the application of controls described in Table 6-21 (including rehabilitation), the likelihood level of potential impacts is reduced to 'unlikely' and the consequence ranking assigned a 'level 2', resulting in an overall risk ranking of 2.

***ALARP Discussion***

The impacts and risks associated with erosion is considered a decision 'Type A', meaning that they are well-understood and that there are established practices in place to manage these risks.

With implementation of the control measures, it is considered that the risks and impacts of erosion have been reduced to ALARP.

***Statement of acceptability***

The residual risk for noise is 1. Using Santos' model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.

**Table 6-22 Erosion Residual Risk Ranking**

Receptor	Risk or Impact	Pre-treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Native flora	Smothering of undisturbed vegetation	3	Minimise disturbance to native vegetation and fauna	Unlikely	II	1	Type A	Demonstrated	Y
Baseline water conditions	Increased runoff	3	Minimise disturbance to drainage patterns and avoid contamination of surface waters and shallow groundwater resources	Unlikely	II	1	Type A	Demonstrated	Y
	Increased sediment loads	2		Unlikely	II	1	Type A	Demonstrated	Y
	Disturbance to natural drainage patterns	2		Unlikely	II	1	Type A	Demonstrated	Y
Native Flora	Direct loss of vegetation	2	Minimise disturbance to native vegetation and native fauna	Unlikely	II	1	Type A	Demonstrated	Y
Cultural heritage	Disturbance to culturally sensitive sites	2	Avoid disturbance to sites of cultural, sacred and heritage significance	Unlikely	II	1	Type A	Demonstrated	Y
Livestock, pastoral infrastructure and landholders	Disturbance to landholders	2	Minimise disturbance to livestock, pastoral infrastructure and landholders	Unlikely	II	1	Type A	Demonstrated	Y

### 6.3.3 Introduction of Pests and Pathogens

Pests and pathogens may be introduced throughout the project. The area where introduced pest and pathogens may occur could be anywhere within the project footprint where vehicles, plant and equipment are required to access as a part of the activity.

#### ***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be potentially impacted by introduced pest and pathogens are summarised in Table 6-23.

**Table 6-23 Introduced Pest and Pathogens Receptor risks and impacts**

Receptor	Potential Impact
Native flora	Introduction and or spread of weeds, pest plants, animals and pathogens.
Native fauna	Introduction and or spread of weeds, pest plants, animals and pathogens.
Soil	Introduction or spread of pathogens.
Livestock, pastoral infrastructure and landholders	Disturbance to Livestock

#### ***Evaluation of Environmental Impacts***

Weeds are an increasing threat to the region's natural, cultural and economic assets (NTG 2017). Pests and pathogens can be transported to the project footprint via vehicles, equipment, personnel, and any other materials required such as soils and gravel. Locally established weeds can also be spread as a result of increased vehicle traffic, and vehicles through the project footprint. During this time, there is the risk that pest species could be introduced or spread within the project footprint.

##### *Native Flora and soils*

Weeds threaten the survival of native vegetation if they outcompete flora for nutrients, habitat and sunlight. Once established, weed species often produce large quantities of seeds, allowing them to spread quickly and efficiently. Once established, weeds can be difficult to manage and therefore preventing initial introduction and spread of certain species is the most effective form of weed management.

Pathogen introduction in vegetation or within soils can cause disease in native flora, and is quick to spread.

Pest animals can have a detrimental impact to native flora as a result of over grazing, alterations in the food chain and degradation of land through uprooting of plants and burrowing.

##### *Fauna and Livestock*

Pest animals can have a detrimental effect on native fauna and livestock through competition for food and habitat, as well as direct predation of native species. Some pests cause changes to natural habitats through selective grazing of favoured plant species, or degradation of land by uprooting plants and burrowing.



Pathogen introduction can cause disease in native fauna and livestock, as well as affect viability of food and habitats.

Table 6-24 provides a summary assessment of the potential risk ranking to environmental receptors due to introduced pest and pathogens.

**Table 6-24 Introduced Pest and Pathogens Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Native flora	Introduction and or spread of weeds, pest plants, animals and pathogens.	Likely	IIII	4	NT Government Aboriginal groups
Native fauna	Introduction and or spread of weeds, pest plants, animals and pathogens.	Occasional	IIII	3	NT Government Aboriginal groups
Soil	Introduction or spread of pathogens.	Possible	III	2	Landholders Government
Livestock, pastoral infrastructure and landholders	Disturbance to Livestock	Possible	III	2	Landholders

**Control Measures**

To prevent introduced pests and pathogens and mitigate the potential risks and impacts the control measures outlined in Table 6-25 will be implemented.

**Table 6-25 Controls to reduce risk and impacts of Introduced pests and pathogens**

Receptors	Control
All	Weed wash-down certification for vehicle and machinery from interstate.
	Ensure site environmental inductions for all site personnel and contractors include vehicle weed hygiene requirements and information on exotic invasive ants.
	All vehicle and equipment movements to stay on formed access tracks and seismic lines.
	Ensure vehicles, machinery and equipment entering the permit areas have been cleaned and are free of soil and vegetative matter, or have a valid weed hygiene certificate.
	A baseline weed assessment will be completed prior the commencement of works covered in this EMP.
	The baseline assessment will assess and map all infestations of declared weeds

Receptors	Control
	Baseline data will be collected in consultation with the Department of Environment and Natural Resources (DENR) and data will be provided to DENR in a format to be specified by them.
	Areas of priority weeds identified will be marked.
	If infestations of priority weed species are identified during water monitoring bore drilling program, they will be avoided, where possible, via a detour around the infestation.
	If infestations are unavoidable, infestations will be crossed at the narrowest point and wash downs will be conducted once exiting the infestation.
	Any onsite wash down sites will be marked for further monitoring.
	Undertake post-activity weed assessment and monitoring.

**Post treatment risk**

Previous baseline assessments of Tanumbirini Station have determined that, relative to neighbouring properties Tanumbirini Station is relatively weed free. Given the location of the project and the relatively small area of disturbance, together with the proposed controls and commitments to conduct baseline assessment and monitoring, the potential for introduced pests and pathogens is reduced to an acceptable level. With the application of controls described in Table 6-25, the likelihood level of potential impacts is reduced to ‘unlikely’ and the consequence ranking assigned a ‘level 4’, resulting in an overall risk ranking of 2 (Table 6-26).

**ALARP discussion**

The impacts and risks associated with introduced pests and pathogens are considered to be a decision Type A, meaning that they are well-understood and that there are established practices in place to manage these risks. With implementation of the control measures, it is considered that the risks and impacts of introduced pests and pathogens have been reduced to ALARP.

**Statement of acceptability**

The residual risk for contamination resulting from introduction of pests and pathogens is 2. Using Santos’ model for acceptance, this is considered to be acceptable providing that ALARP has been achieved and is demonstrated.

**Table 6-26 Introduced Pest and Pathogens Residual Risk Ranking**

Receptor	Risk or Impact	Pre-Treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Native flora	Introduction and or spread of weeds, pest plants, animals and pathogens.	4	Minimise disturbance to native fauna	Unlikely	IV	2	Type A	Demonstrated	Y
Native fauna	Introduction and or spread of weeds, pest plants, animals and pathogens.	3	Minimise disturbance to native flora	Unlikely	IV	2	Type A	Demonstrated	Y
Soil	Introduction or spread of pathogens.	2	Minimise negative impacts to soil quality	Unlikely	IV	2	Type A	Demonstrated	Y
Livestock, infrastructure and landholders	Disturbance to Livestock	2	Minimise disturbance to livestock	Unlikely	IV	2	Type A	Demonstrated	Y

### 6.3.4 Fire

Fire may occur from vehicle exhausts and sparks from machinery vehicle exhausts, sparks from machinery, careless disposal of cigarettes or rehabilitation activities.

#### ***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be potentially impacted by fire are summarised in Table 6-27.

**Table 6-27 Fire Receptor risks and impacts**

Receptor	Potential Impact
Native flora	Loss of vegetation
Native fauna	Disturbance, injury or death
Livestock, pastoral infrastructure and landholders	Disturbance, injury or death to livestock Damage/loss to dwellings, infrastructure

#### ***Evaluation of Environmental Impacts***

Fires can start due to various factors such as heat from vehicle exhausts, sparks from machinery or careless disposal of cigarettes. A fire caused by the activity could start in the vicinity of the project footprint.

The project activity will be undertaken in accordance with the recommendations of the Fire and Emergency Act 2015 and the Bushfire Act 2009.

#### ***Native Flora***

Bushfires are a natural occurrence in areas of bush and scrubland and are an essential part of the life cycle for many native flora, promoting reproduction and growth in the long term. Uncontrolled man-made fires and altered long-term fire regimes can be devastating to large areas of vegetation, resulting significant impacts to flora.

Most native flora in bush/ scrub habitats implement survival strategies to protect tissue from heat which would otherwise destroy them. Fire resistance and tolerance is exhibited through: bark thickness, other vegetative insulation, above-ground re-sprouting, underground roots and stems.

Following a fire event, change in conditions such as increased light availability and changes to nutrient levels can result in a temporary cyclical change to floral assemblage in the area. This is not necessarily a negative impact, as post-fire plant responses include increased productivity and flowering, fire stimulated seed release and dispersal, and improved seedling germination.

Overall, negative impacts associated with fire on native flora could be widespread, however in the absence of altered long-term fire regimes, populations are likely to recover over time.

#### ***Native Fauna***

As with native flora, most native fauna species in fire-risk areas are adapted to tolerate or respond to fire in a way that aids survival. Survival responses include moving away from the area, burrowing to escape heat, and active use of the fire and burnt areas for feeding

opportunities (such as birds of prey targeting rodents flushed from undergrowth by heat). Mortality resulting from fire is generally low, as most animals are able to move away from the affected area, however higher levels of mortality can be seen in flightless invertebrates and insects in vulnerable stages of development.

Dispersal from an area has ongoing impacts to the post-fire habitat, as animals will return at different rates resulting in a constantly evolving food chain. Changes to vegetation will also impact on fauna, changing food sources for herbivores and omnivores.

Any short term impacts would be recoverable, with fauna quickly returning to an area post-fire.

*Livestock, pastoral infrastructure and landholders*

Livestock are considerably more vulnerable to bushfire than native fauna, as their escape is limited and they have not adapted to the natural environment. Although livestock are mobile and able to move away from bushfire, they are often limited by the boundaries of landowners' land. Fences / ditches can hinder movement of livestock, effectively trapping them within the fire path.

Landowners are impacted by any impacts on livestock as this will affect the viability of the operations. Similarly, a loss of infrastructure such as fencing and buildings would have an impact on the livelihood of landowners.

During a bushfire, any building / physical structures built with flammable materials such as wood are at risk. Burning of building can result in loss of assets and potentially impact livelihood. In extreme cases, it could result in loss of life.

Table 6-28 provides a summary assessment of the potential risk ranking to environmental receptors due to fire.

**Table 6-28 Fire Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Native flora	Loss of vegetation	Occasional	II	2	NT Government
Native fauna	Disturbance, injury or death to native fauna	Occasional	II	2	NT Government
Damage/loss to dwellings, infrastructure	Disturbance, injury or death to Livestock	Occasional	II	2	Landholders
	Damage/loss to dwellings, infrastructure	Occasional	II	2	Landholders

**Control Measures**

To prevent fire and mitigate the potential risks and impacts the control measures outlined in Table 6-29.

**Table 6-29 Controls to reduce risk and impacts of fire**

Receptor	Control
All	Include fire season education as part of the induction.
	Use of qualified water bore driller contractors with Northern Territory dry season experience.
	All vehicles will be equipped with portable fire extinguishers.
	Machinery and vehicles should be parked in areas of low fire risk and be free of any combustible material, for example in the case of dry grass build up.
	All vehicles will be equipped with fully operational VHF and / or UHF radio transceivers.
	Smoking will only be permitted in areas clear of vegetation, and there will be no disposal of butts.
	All personnel will receive information prior to the commencement of the activity relating to: <ul style="list-style-type: none"> <li>• Provisions of the Emergency Response Plan including procedures during a fire emergency</li> <li>• The operation of firefighting equipment and communications</li> <li>• Restricted smoking requirements</li> </ul>
	Toolbox meetings will be conducted to: <ul style="list-style-type: none"> <li>• Alert the workforce of the fire risk level for the day</li> <li>• Discuss any fire risk management breaches and remedial actions</li> </ul>

**Post treatment risk**

Given the proposed controls, the potential for fire is reduced to an acceptable level. With the application of controls described in Table 6-29 the likelihood level of potential impact remains 'unlikely' and the consequence ranking assigned a 'level 2', resulting in an overall risk ranking of 2 (Table 6-30).

**ALARP discussion**

The impacts and risks associated with fire are considered to be a decision Type A, meaning that they are well-understood and that there are established practices in place to manage these risks.

With implementation of the control measures, it is considered that the risks and impacts of fire have been reduced to ALARP.

**Statement of acceptability**

The residual risk for fire is 1. Using Santos' model for acceptance, this is considered to be acceptable providing that ALARP has been achieved and is demonstrated.



**Table 6-30 Fire Residual Risk Ranking**

Receptor	Risk or Impact	Pre-Treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Native flora	Loss of vegetation	2	Minimise disturbance to native fauna	Unlikely	II	1	Type A	Demonstrated	Y
Native fauna	Disturbance, injury or death	2	Minimise disturbance to native flora	Unlikely	II	1	Type A	Demonstrated	Y
Damage/loss to dwellings, infrastructure	Disturbance, injury or death to Livestock	2	Minimise disturbance to livestock	Unlikely	II	1	Type A	Demonstrated	Y
	Damage/loss to dwellings, infrastructure	2	Minimise disturbance to landowners	Unlikely	II	1	Type A	Demonstrated	Y

**6.3.5 Disturbance to Stakeholders**

The area where disturbance to stakeholders may occur could be anywhere vehicles are required to access as a part of the activity. For this EMP, this will be limited to the project footprint described in Section 4.2.

***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be potentially impacted by disturbance to stakeholders are summarised in Table 6-31.

**Table 6-31 Disturbance to stakeholders Receptor risks and impacts**

Receptor	Potential Impact
Livestock, pastoral infrastructure and landholders	Unplanned interaction with or disturbance to other land users

***Evaluation of Environmental Impacts***

The proposed activities is short-term, to be completed in November 2018. The most likely scenario will involve unplanned vehicle movements.

***Landholder / infrastructure***

Unplanned interactions with / disturbance to landholders or landholders’ infrastructure could occur during vehicle movement within the project footprint, such as disturbance to a road/track, damage to signage, damage to fencing or other infrastructure. The presence of the project activity in the project footprint could also result in unplanned disturbance such as temporary exclusion from land areas or increases in vehicle traffic. Any disturbance / interaction would be temporary and short-lived.

All planned impacts, such as those involving physical presence of the operations are discussed in Section 6.2.1.

Table 6-32 provides a summary assessment of the potential risk ranking to environmental receptors due to disturbance to stakeholders.

**Table 6-32 Disturbance to Stakeholders Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Livestock, pastoral infrastructure and landholders	Unplanned interaction with or disturbance to other land users	Likely	I	2	Landholders

***Control Measures***

To prevent disturbance to stakeholders and mitigate the potential risks and impacts the control measures outlined in Table 6-33 will be implemented.

**Table 6-33 Controls to reduce risk and impacts of Disturbance to stakeholders**

Aspect	Control
Disturbance to Stakeholders	Relevant landowners and occupiers are notified prior to activity.
	Damage and degradation of station tracks is avoided.
	Inductions for all employees and contractors cover pastoral, conservation, legislation and infrastructure issues.
	All litter is to be managed and disposed of correctly.
	Speeds on private unsealed roads will be limited to a maximum of 80 km/hr
	All gates are left in the condition in which they were found (i.e. open / closed).
	When necessary, all fences are restored to satisfaction of landowner / managers.

**Post treatment risk**

Given the location of the project and the relatively small area of disturbance, together with the proposed controls, the potential for disturbance to stakeholders is reduced to an acceptable level. With the application of controls described in Table 6-33, the likelihood level of potential impacts is reduced to 'possible' and the consequence ranking assigned a 'level 1', resulting in an overall risk ranking of 1 (Table 6-34).

**ALARP discussion**

The impacts and risks associated with disturbance to stakeholders are considered to be a decision Type A, meaning that they are well-understood and that there are established practices in place to manage these risks. With implementation of the control measures, it is considered that the risks and impacts of disturbance to stakeholders have been reduced to ALARP.

**Statement of acceptability**

The residual risk for disturbance to stakeholders is 1. Using Santos' model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.

**Table 6-34 Disturbance to Stakeholders Residual Risk Ranking**

Receptor	Risk or Impact	Pre-Treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Livestock, pastoral infrastructure and landholders	Unplanned interaction with or disturbance to other land users	2	No unplanned interactions or disturbance to landholders	Possible	I	1	Type A	Demonstrated	Y

### 6.3.6 Waste and Chemical leaks and spills

The potential impact of a spill or leak is dependent on the type and volume of material released. There are a small number of chemicals and hydrocarbons stored and transported for the project. Primarily this will be hydrocarbon fuel stored within water bore drill rig and vehicles used for transport to and from the water bore lease pad as well as any drilling fluids (see Section 3.7).

Putrescible and municipal waste will be generated by the project and will be segregated and transported to an approved facility.

#### ***Sensitive Environmental Receptors with the Potential to Occur within the Project footprint***

Based upon the receptors identified in Section 4.0, those known to be potentially impacted by waste and chemical spills and leaks are detailed in Table 6-35.

**Table 6-35 Waste and chemical spills and leaks Receptor risks and impacts**

Receptor	Potential Impact
Surface Water	Reduction in surface water quality
Groundwater	Reduction in groundwater quality
Soil	Reduction in soil quality
Native fauna	Attraction to inappropriately stored waste

#### ***Evaluation of Environmental Impacts***

The proposed activities are short-term, to be completed in November 2018. During this time, there is the potential for leaks and spills of stored materials including hydrocarbons within the project area. Spills or leaks would likely be lost to ground, especially on highly permeable soils, with a component of high volatility fuels such as diesel undergoing evaporation.

The risk of spills is present where the water bore drill rig and vehicles are operating. The scale of a potential spill is limited by the quantity of fuel and other materials stored and used as part of the water bore drilling program.

Leaks and spills could potentially result in a loss of soil and water quality, and subsequent risk to livestock, flora and fauna habitat, and public health.

#### ***Baseline water conditions***

Water resources in the area can be characterised as either surface waters or ground water. Spills to surface waters such as ephemeral water courses and creeks have the potential to degrade water quality and potentially impact native fauna or stock that access the water. Small spills to surface waters would rapidly dilute, however larger spills have the potential to spread with the flow of water and cause impacts further from the source.

Large spills to land have the potential to reach the water table and cause groundwater contamination. In addition groundwater contamination can occur through the construction of the groundwater monitoring bores that create a conduit to the groundwater resource. Groundwater

contamination may impact on the beneficial uses of the groundwater resource which could include stock watering or human consumption.

Although groundwater contamination may impact on the beneficial uses of the groundwater resource consumers which could include native fauna and flora, stock or humans, the water bore drilling will be conducted in accordance with the Minimum Construction Requirements for Water Bores in Australia (3rd edition). This is the accepted authority in all states and territories for the minimum requirements on constructing, maintaining, rehabilitating and decommissioning water bores in Australia. Drillers and state/territory water authorities use the minimum construction requirements as a consistent standard reference across Australia for the licensing of bores and drillers. The requirements focus on protecting groundwater resources from contamination, deterioration and uncontrolled flow associated with poorly constructed bores and on the construction of bores to provide a clean water supply.

*Soil*

Soil types within the project area are mostly sandy, with high levels of permeability. For smaller spills and leaks contamination is likely to be contained within the surface soils and would be readily removed or remediated. If a larger spill were to occur, there is the potential that product could infiltrate soils to depth and potentially reach groundwater. It is considered highly unlikely that the water bore drilling project would result in a spill large enough to infiltrate soils to depth or reach groundwater

*Native fauna*

When waste is stored incorrectly, it can attract native fauna in to the campsite. This can lead to impacts to native fauna when interacting with operations personnel. Due to the short-term nature of operations and relatively small levels of waste, this impact is considered to be short-term and localised and unlikely to occur.

Table 6-36 provides a summary assessment of the potential risk ranking to environmental receptors due to waste and chemical spills and leaks.

**Table 6-36 Waste and chemical spills and leaks Pre-treatment risk ranking**

Receptor	Risk or Impact	Likelihood	Consequence	Risk Ranking	Relevant Stakeholders
Baseline water conditions	Reduction in surface water quality	Possible	III	2	NT Government
Soil	Reduction in soil quality	Occasional	II	2	Landowner
Native fauna	Attraction to inappropriately stored waste	Likely	I	2	Landowner

**Control Measures**

To prevent waste and chemical spills and leaks and mitigate the potential risks and impacts the control measures outlined in Table 6-37 will be implemented.



**Table 6-37 Controls to reduce risk and impacts of waste and chemical spills and leaks**

Receptors	Control
All	Licenced waste contractor will be used where appropriate.
	Water bore drilling will be conducted by a licenced contractor
	Spill kits available to treat spills in situ
	Water bore drilling will be conducted in accordance with the Minimum Construction Requirements for Water Bores in Australia (3rd edition)
	Waste will be segregated on site and all putrescible waste material will be held in fauna proof containers.
	Any spills contained and retrieved.
	Any spills will be remediated to the satisfaction of the landholder, fenced, soil removed to appropriate facility and signed off by land holder in accordance with the access
	Fuel and other lubricants will be appropriately stored and managed, in accordance with AS1940.

**Post treatment risk**

Given the waste and chemical spills and leaks, together with the proposed controls, the potential for waste and chemical spills and leaks is reduced to an acceptable level. With the application of controls described in

Table 6-37, the likelihood level of potential impacts is overall risk ranking of 1 (Table 6-38).

**ALARP discussion**

The impacts and risks associated with waste and chemical spills and leaks are considered to be a decision Type A, meaning that they are well-understood and that there are established practices in place to manage these risks.

With implementation of the control measures, it is considered that the risks and impacts from waste and chemical spills and leaks have been reduced to ALARP.

**Statement of acceptability**

The residual risk for waste and chemical spills and leaks is 1. Using Santos’ model for acceptance, this is considered to be acceptable and it is assumed that ALARP has been achieved.

**Table 6-38 Waste and chemical spills and leaks Residual Risk Ranking**

Receptor	Risk or Impact	Pre-Treatment Risk Ranking	Outcome	Likelihood	Consequence	Risk Ranking	ALARP	Acceptability	Accept Y/N
Baseline water conditions	Reduction in surface water quality	2	Minimise disturbance to surface water	Unlikely	II	1	Type A	Demonstrated	Y
Soil	Reduction in soil quality	2	Minimise reduction in soil quality	Unlikely	II	1	Type A	Demonstrated	Y
Native fauna	Attraction to inappropriately stored waste	2	Minimise disturbance to native fauna	Possible	I	1	Type A	Demonstrated	Y

## 6.4 Principles of Environmentally Sustainable Development

As a factor to the determination of whether a risk or impact is acceptable, consideration has been made of the principles of ESD. The principles and how they have been considered in this EMP are described below:

**A. *Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations.***

This principle is inherently met through the EMP assessment process via the consideration of potential impacts and risks and stakeholder input. Longer term considerations are followed through via the restoration process and long-term revisits to confirm rehabilitation success.

**B. *If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.***

The Environmental Risk Assessment within this EMP demonstrates that threats of serious or irreversible damage are highly unlikely. The proposed activity and receiving environment are well understood and Santos' ALARP decision framework considers 'risk and uncertainty' as part of the decision-making context. In this framework, a risk that involves significant uncertainty would require a precautionary approach to hazard management and analysis would be replaced by conservative assumptions such that additional controls are more likely to be implemented.

**C. *The principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.***

Where the potential impacts and risk are determined to be serious or irreversible the precautionary principle is implemented to ensure the environment is maintained for the benefit of future generations. The Environmental Risk Assessment within this EMP demonstrates that potential impacts and risks will be reduced to ALARP and acceptable levels.

**D. *The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making.***

The potential to impact biological diversity and ecological integrity is inherent within the EMP assessment process. The Environmental Risk Assessment within this EMP demonstrates that potential impacts and risks will be reduced to ALARP and acceptable levels.

**E. *Improved valuation, pricing and incentive mechanisms should be promoted.***

Not relevant to this EMP.

## **7.0 ENVIRONMENTAL OUTCOMES, PERFORMANCE STANDARDS, MEASUREMENT CRITERIA**

Santos is committed to ensuring that its activities are undertaken in a manner that is environmentally responsible through setting Environmental Outcomes (EO) and Environmental Performance Standards (EPS).

Under the Regulations, an EMP must include EO that address the risks that are identified in section 5.0. The EOs must address legislative and other controls that manage the environmental aspects of the activity.

For each EO, there must be at least one related EPS, that either reduces the likelihood of the risk or impact occurring, or reducing the impact or consequence of the risk. The EPS intend to validate the controls that have been implemented to manage the environmental risks. An EPS will relate to the quality of the control in place, including people, systems, equipment and procedures.

For each EO and its relevant EPS, specifically related measurable criteria should be included to measure the performance against the EO and EPSs. These Measurement Criteria (MC) must enable a determination to be made on whether the EOs and EPSs are being consistently met. The EOs, EPSs and MC for the water monitoring bore drilling program are described in Table 7-1.

**Table 7-1 Environmental Outcomes, Environmental Performance Standards and Measurement Criteria**

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
<b>Physical Disturbance</b>	General controls	All personnel are given environmental and cultural heritage inductions prior to commencing work. Inductions for all employees and contractors cover pastoral, conservation, legislation and infrastructure issues.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		Activities to be planned to minimise new land disturbance by utilising previous disturbed areas or existing tracks (where possible), and through operational practices including weaving	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
	Minimise disturbance to native fauna	Clearing of vegetation for track upgrades will be prohibited.	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
		Flora rootstock will be left intact to promote regeneration.	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
		Steep terrain will be avoided (where possible).	No new roads in steep terrain.	Santos Field Representative
		No Hollow timber/trees will be cleared	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
	Minimise disturbance to natural drainage patterns	Alteration of natural drainage contours or lines will be avoided.	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
	Minimise disturbance of soil resources.	An all-terrain water bore drill rig will be used.	Only contract a water bore drilling contractor who will use an all-terrain water bore drill rig will be used	Santos Environmental Lead Representative
		Alteration of natural drainage contours or lines will be avoided and/or bypass structures installed to minimise obstruction to flow	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
		Erosion and sediment control structures (e.g. berms, sediment fences) to be installed and maintained where necessary.	Erosion and Sediment Control Plan has been developed	Santos Field Representative
		Inversion of the soil profile will be minimised where possible	Daily checklist confirms all clearing is in accordance with Environmental Performance Standards	Santos Field Representative
	Avoid disturbance to sites of cultural, sacred and heritage significance.	Disturbance is restricted to areas for which NLC clearance has been provided.	GIS database that includes project areas and cultural heritage sites	Santos GIS Coordinator
		Disturbance is restricted to subject land as detailed in the AAPA Authority Certificate.	GIS database that includes project areas and cultural heritage sites	Santos GIS Coordinator
		Known sites of sacred or cultural significance are identified and avoided.	Details of sacred and cultural significant sites included in GIS database and utilised when determining project footprint (and provided to project personnel as part of induction)	Santos GIS Coordinator
		Any new sites identified during the activity will be reported to the Santos Cultural Heritage Team and avoided.	Details of new heritage sites included in GIS database	Santos GIS Coordinator
		Maintain GIS database of project footprint and cultural heritage sites including details of any works conditions.	GIS database that includes project areas and cultural heritage sites	Santos GIS Coordinator

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
	Minimise disturbance to livestock, pastoral infrastructure and landholders.	Relevant landowners and occupiers and relevant third-party tenement holders are notified prior to activity.	Notice of Entry completed before works undertaken	Santos Field Representative
		All gates are left in the condition in which they were found (i.e. open / closed).	Notice of entry, Incident management systems	Santos Field Representative
		Damage to station tracks is avoided and reported if does occur.	Notice of entry, Incident management systems	Santos Field Representative
		Unauthorised offline driving is prohibited for all project personnel.	Landholder complaints logged (and any corrective action) in complaints register	Santos Field Representative
		When necessary, all fences are restored to satisfaction of landowner / managers.	Landholder complaints logged (and any corrective action) in complaints register	Santos Field Representative
		System is in place for logging landholder complaints to ensure that issues are addressed as appropriate.	Complaints register in place	Santos Field Representative
<b>Atmospheric Emissions</b>	Minimise reduction in air quality	Personnel are given environmental and cultural heritage inductions prior to commencing work.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Field Representative
	Minimise smothering of undisturbed vegetation	Where possible, existing tracks, roads or seismic lines will be used for access.	GIS data showing approved access	Santos GIS Coordinator
	Minimise disturbance to fauna	Off track driving is prohibited – no bush bashing or short cuts are permitted.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Field Representative
	Minimise loss of amenity	Speeds on unsealed roads will be limited – max 80 km/hr on unsealed roads, 40 km/hr on water bore access tracks and seismic lines.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Field Representative



Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
		Any remediation work should be undertaken upon completion of all activities.	In-vehicle Monitoring System (IVMS) weekly reports. remediation work scheduled to occur as soon as possible.	Santos Field Representative
<b>Noise</b>	Minimise disturbance to native fauna, landholders and livestock	Personnel are given environmental and cultural heritage inductions prior to commencing work.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Field Representative
		Relevant landholders and occupiers are consulted with respect to water bore locations.	Notice of Entry completed before works undertaken	Santos Field Representative
		Landholders are provided updates on progress throughout the project (both water monitoring bore drilling and groundwater monitoring events).	Communications procedure with landholders	Santos Field Representative
		Maintain communications during operations with relevant landholders.	Project Plan which details daily works scopes and timing	Santos Field Representative
		Water bore drilling will only occur during daylight hours.	Project Plan which details daily works scopes and timing	Santos Field Representative
<b>Fauna Interaction</b>	Minimise disturbance to native fauna, landholders and livestock	Driving will only occur during daylight hours	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		Personnel are given environmental and cultural heritage inductions prior to commencing work.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		Off track driving is banned – no bush bashing or short cuts are permitted.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
		Relevant landowners and occupiers are notified prior undertaking activities.	Notice of Entry completed before works undertaken	Santos Field Representative
		All gates are left in the condition in which they were found (i.e. open / closed).	Notice of Entry completed before works undertaken	Santos Field Representative
		When necessary, all fences are restored to satisfaction of landowner / managers.	Incident management systems	Santos Field Representative
		Speed will be limited along lines to 40km/hr and 80km/hr on other unsealed roads.	Incident management systems	Santos Field Representative
		All vehicle routes have speed limits set which must be adhered to.	IVMS weekly reports	Santos Field Representative
<b>Erosion</b>	Minimise disturbance of soil resources	Disturbance is restricted to areas for which consent has been provided.	All activities will comply with the land access agreements.	Santos Field Representative
	Minimise disturbance to drainage patterns of surface waters and shallow groundwater resources,	No clearing of vegetation for access.	All activities will comply with the land access agreements.	Santos Field Representative
	Minimise disturbance to native vegetation and native fauna,	Due to the instability and erosion potential when disturbed, the steeper slopes and escarpments of tableland land systems are avoided.	Inductions to inform operators that disturbance to steeper slopes are to be avoided when possible	Santos Field Representative
	Minimise disturbance to culturally sensitive sites,	Creek bank vegetation is left intact and detours sought if too dense to pass through.	No removal of creek bank vegetation.	Santos Field Representative
	Minimise disturbance to livestock, pastoral infrastructure and landholders	Unavoidable compaction in areas other than those susceptible to erosion, will be ripped on completion of work.	Any restoration work required is scheduled to be follow water bore drilling activities.	Santos Field Representative

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
		Any remediation work should be undertaken upon completion of all activities.	Any remediation work required is scheduled to be follow water bore drilling activities.	Santos Field Representative
		Unauthorised offline driving is prohibited for all project personnel.	No unauthorised offline driving.	Santos Field Supervisor
		Operations are shut down during wet weather or flooding and only restarted once potential for extensive damage has passed.	Project Plan and all project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Field Supervisor
		Following shut down due to flooding or inundation the risk assessment will be re-visited to ensure controls are still appropriate to manage risk to ALARP.	Project Plan and all project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
<b>Introduced Pests and Pathogens</b>	Minimise disturbance to native fauna	Weed wash-down certification for vehicle and machinery from interstate.	A register of vehicle / equipment / machinery cleaning is kept.	Santos Field Supervisor
	Minimise disturbance to native flora	Ensure site environmental inductions for all site personnel and contractors include vehicle weed hygiene requirements and information on exotic invasive ants.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
	Minimise negative impacts to soil quality			
	Minimise disturbance to livestock	All vehicle and equipment movements to stay on formed access tracks and seismic lines.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		Ensure vehicles, machinery and equipment entering the permit areas have been cleaned and are free of soil and vegetative matter, or have a valid weed hygiene certificate.	A register of vehicle / equipment / machinery cleaning is kept.	Santos Field Representative

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
		A baseline weed assessment will be completed prior the commencement of works covered in this EMP.	Baseline Weed Assessment documentation	Santos Environment Lead
		The baseline assessment will assess and map all infestations of declared weeds	Baseline Weed Assessment documentation	Santos Environment Lead
		Baseline data will be collected in consultation with the Department of Environment and Natural Resources (DENR) and data will be provided to DENR in a format to be specified by them.	Baseline Weed Assessment documentation	Santos Environment Lead
		Areas of priority weeds identified will be marked.	Baseline Weed Assessment documentation	
		If infestations of priority weed species are identified during water monitoring bore drilling program, they will be avoided, where possible, via a detour around the infestation.	Maintain demarcation during operations and inspect (and rectify if needed) daily.	Santos Field Representative
		If infestations are unavoidable, infestations will be crossed at the narrowest point and wash downs will be conducted once exiting the infestation.	Maintain demarcation during operations and inspect (and rectify if needed) daily.	Santos Field Representative
		Any onsite wash down sites will be marked for further monitoring.	Maintain demarcation during operations and inspect (and rectify if needed) daily.	Santos Field Representative
		Undertake post-activity weed assessment and monitoring.	Reports from weed monitoring program	Santos Environmental Lead
<b>Fire</b>	Minimise disturbance to native fauna	Include fire season education as part of the induction.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
	Minimise disturbance to native flora	Use of qualified water bore driller contractors with Northern Territory dry season experience.	Project plan and procurement to ensure qualified water bore driller contractors	Santos D&C
	Minimise negative impacts to landholders	All vehicles will be equipped with portable fire extinguishers.	Weekly checklist confirms all fire fighting equipment and procedures are in place in accordance with Environmental Performance Standards	Santos Field Representative
	Minimise disturbance to livestock	Machinery and vehicles should be parked in areas of low fire risk and be free of any combustible material, for example in the case of dry grass build up.	IVMS weekly reports	Santos Field Representative
		All vehicles will be equipped with fully operational VHF and / or UHF radio transceivers.	Weekly checklist confirms all fire fighting equipment and procedures are in place in accordance with Environmental Performance Standards	Santos Field Representative
		Smoking will only be permitted in areas clear of vegetation, and there will be no disposal of butts.	Incident management systems	Santos Field Representative
		All personnel will receive information prior to the commencement of the activity relating to: <ul style="list-style-type: none"> <li>Provisions of the Emergency Response Plan including procedures during a fire emergency</li> <li>The operation of firefighting equipment and communications</li> <li>Restricted smoking requirements</li> </ul>	All project staff undertaken a environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		Toolbox meetings will be conducted to: <ul style="list-style-type: none"> <li>Alert the workforce of the fire risk level for the day</li> <li>Discuss any fire risk management breaches and remedial actions</li> </ul>	Records of toolbox meetings which indicate when there is a high fire risk in place.	Santos Field Representative

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
<b>Disturbance to stakeholders</b>	No unplanned interactions or disturbance to landholders	Relevant landowners and occupiers are notified prior to activity	Consultation records	Santos Field Representative
		Damage and degradation of station tracks is avoided.	Incident management systems	Santos Field Representative
		Inductions for all employees and contractors cover pastoral, conservation, legislation and infrastructure issues.	All project staff undertaken an environmental and cultural induction as recorded in the Santos Training Register	Santos Environment Lead
		All litter is to be managed and disposed of correctly.	Incident management systems	Santos Field Representative
		Speeds on private unsealed roads will be limited to a maximum of 80 km/hr	IVMS weekly reports	Santos Field Representative
		All gates are left in the condition in which they were found (i.e. open / closed).	Incident management systems	Santos Field Representative
		When necessary, all fences are restored to satisfaction of landowner / managers.	Incident management systems	Santos Field Representative
<b>Wastes and chemical leaks and spills</b>	Minimise disturbance to surface water, groundwater, soil quality and native fauna	Licensed waste contractor will be used where appropriate.	Waste records	Santos Field Representative
		Water bore drilling will be conducted by a licensed contractor	Project plan and procurement to ensure qualified water bore driller contractors	Santos D&C
		Spill kits available to treat spills in situ	Weekly checklist confirms all hazardous materials stored and managed in accordance with Environmental Performance Standards	Santos Field Representative

Aspect	Environmental Outcome	Environmental Performance Standards	Measurement Criteria	Responsible person
		Water bore drilling will be conducted in accordance with the Minimum Construction Requirements for Water Bores in Australia (3rd edition)	Project plan and procurement to ensure qualified water bore driller contractors	Santos Environment Lead
		All fuel stored and used should be under the control of qualified or trained personnel.	Weekly checklist confirms all hazardous materials stored and managed in accordance with Environmental Performance Standards	Santos Field Representative
		Waste will be segregated on site and all putrescible waste material will be held in fauna proof containers.	Waste records	Santos Field Representative
		Any spills contained and retrieved.	Incident Management System	Santos Field Representative
		Any spills will be remediated to the satisfaction of the landholder, fenced, soil removed to appropriate facility and signed off by land holder in accordance with the access.	Landholder complaints logged in complaints register	Santos Field Representative
		Fuel and other lubricants will be appropriately stored and managed, in accordance with AS1940 The Storage and Handling of Flammable and Combustible Liquids.	Checklist confirms all hazardous materials stored and managed in accordance with Environmental Performance Standards	Santos Field Representative



## 8.0 IMPLEMENTATION STRATEGY

The Implementation Strategy described in this section is a summary of the Santos systems, practices and procedures in place to manage the environmental risk of the water bore monitoring program. The strategy aims to ensure that the control measures, environmental performance outcomes and standards, detailed in Section 7, are implemented and monitored to ensure environmental impacts and risks are continually identified and reduced to a level that is ALARP and acceptable.

### 8.1 Santos EHS Management System

Santos manages the environmental impacts and risks of its activities through the implementation of the Santos Management System (SMS). The SMS provides a formal and consistent framework for all activities of Santos employees and contractors. The Santos SMS Framework is provided in Figure 8-1.

The framework for the SMS includes:

- Constitution, Board Charters, Delegation of Authority - define the purpose and authorities of the Santos Limited Board, Board Committees and senior staff.
- Code of Conduct and Policies – outline the key requirements and behaviours expected of anyone who works for Santos. The Policies are set and approved by the Board.
- Management Standards - prescribe the minimum performance requirements and expectations in relation to the way we work at Santos (the ‘What’).
- Processes, procedures and tools - support implementation of the Management Standards and Policy requirements by providing detail of ‘How’ to achieve performance requirements.

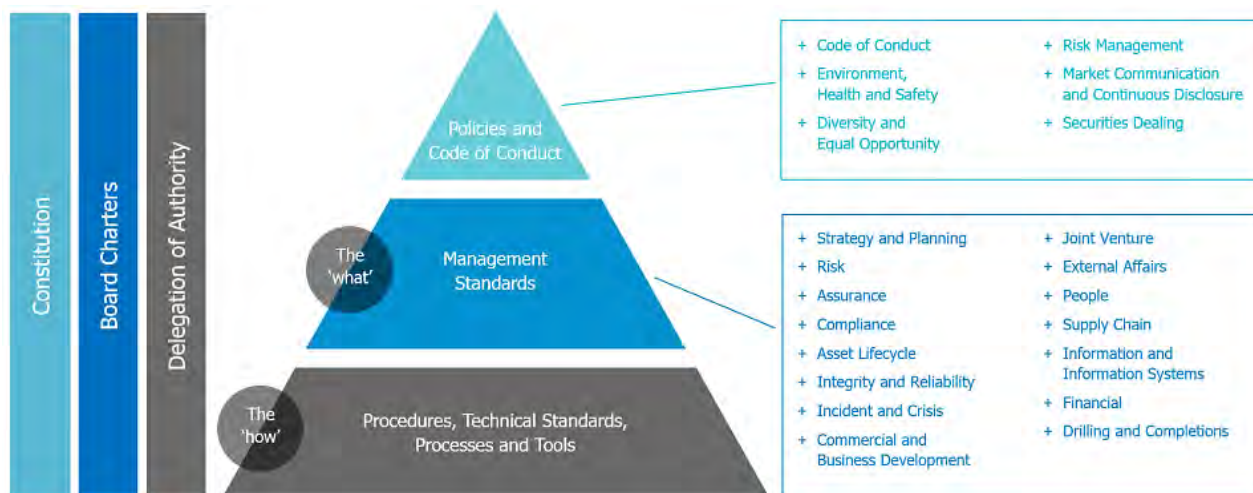


Figure 8-1 Santos Management System Framework

## 8.2 Roles and Responsibilities

Key roles and environmental responsibilities for the activity are detailed in Table 8-1 and will be communicated to these positions prior to the activity commencing and when any changes are made to these positions.

**Table 8-1 Key Personnel Roles and Environmental Responsibilities**

Role	Responsibilities
Santos NT Project Manager	<p>Ensure compliance with SMS including the EHS Policy.</p> <p>Ensure overall compliance with the EMP.</p> <p>Ensure relevant environmental legislative requirements, performance outcomes, control measures, performance standards, measurement criteria and requirements of this EMP are:</p> <p>Communicated to the project key personnel.</p> <p>Included in the Hazard Identification and resulting risk register.</p> <p>Audited to inform the EMP Performance Report.</p> <p>Ensure contractors are competent for the role they are employed for.</p> <p>Report environmental incidents to the Exploration Manager and ensure reporting and investigations undertaken.</p> <p>Ensure records and documents are managed so they are available and retrievable.</p> <p>Ensure non-conformances identified are communicated, raised in EHS Toolbox and corrective actions completed.</p> <p>Review information received from external sources in regards to lessons learnt and non-conformances, relevant to the survey, with the project team to identify if there are actions relevant to the survey. If actions are relevant implement.</p> <p>Review daily Santos Incident Summary Report and communicate relevant incidents and learnings to the Santos Field Representative</p> <p>Ensure the EMP Performance Report is prepared and submitted to DPIR.</p>
NT Exploration Manager	<p>Notify DPIR of a change in titleholder, a change in the titleholder’s nominated liaison person or a change in the contact details for either (Section 8.5).</p> <p>Ensure overall compliance with the EMP.</p> <p>Ensure compliance with SMS including the EHS Policy.</p> <p>Ensure relevant environmental legislative requirements, performance outcomes, performance standards, measurement criteria and requirements in the implementation strategy in this EMP are:</p> <p>Communicated to the activity key personnel.</p> <p>Audited to inform the EMP Performance Report.</p> <p>Ensure the EMP Performance Report is prepared and submitted to DPIR (Section 8.7.5).</p>
Santos Field Representative	<p>Ensure compliance with relevant environmental legislative requirements, performance outcomes, control measures, performance standards, measurement criteria and requirements in the implementation strategy in this EMP.</p>

Role	Responsibilities
	Ensure survey inductions undertaken all field personnel. Ensure changes are assessed and approved by Santos. Report all incidents to the Santos Project Manager. Ensure relevant monitoring records are collated and provided to the Santos Project Manager on completion of the program. Ensure non-conformances and actions are discussed at the daily toolbox meetings including those relevant from other areas of Santos. Ensure corrective actions identified from incidents or inspections are implemented.
Santos Land Access Adviser	Undertake consultation with relevant persons throughout project planning and implementation. Document consultation with relevant persons. Ensure any commitments to relevant persons are undertaken.
Santos Environment Lead	Identify and communicate relevant environmental legislative requirements, performance outcomes, control measures, performance standards, measurement criteria and requirements in the implementation strategy in this EMP to the NT Exploration Manager and NT Projects Manager. Develop the environmental component of the activity induction (Section 8.3). Assess any environmentally relevant changes (Section 8.5). Review any non-conformances relevant to environment performance to ensure corrective actions are appropriate to prevent recurrence (Section 8.7.4). Prepare and submit the EMP Performance Report to DPIR within 3 months of the activity finishing (Section 8.7.5).

### 8.3 Training and Competencies

Santos staff and contractors undertaking work in the field are required to undertake a two-stage induction process. The general Onshore EHS Induction focuses on hazard identification and sets Santos’ expectations for Environment, Health and Safety management for workers at Santos’ onshore operational sites.

The general Onshore EHS Induction is supported by an activity specific induction. All field personnel will be required to complete the activity specific induction that will cover the requirements in this EMP. At a minimum, the induction will cover:

- Activity description
- Key receptors in the area
- Environmental impacts and risks, and associated controls to be implemented
- Management of change process
- Roles and responsibilities
- Incident and non-conformance reporting and management

Key roles for the activity, as detailed in Section 8.2, will be specifically briefed on their roles and responsibilities for this project in addition to the inductions.

Competency of contractors is assessed as part of the contracting qualification and via the prestart audit.

#### 8.4 Emergency Response Plan

The Emergency Response Plan for the activity will be prepared by the water bore drilling contractor and will be provided to DPIR and made available upon request. If the Emergency Response Plan is updated, a revised version will be provided to DPIR.

The emergency response arrangements within the Emergency Response Plan will be exercised early in the campaign to ensure that personnel are familiar with the plan and the type of emergencies to which it applies and that there will be a rapid and effective response in the event of a real emergency occurring. Following the exercise, lessons will be captured and the plan updated if required.

Other triggers for revising or updating the Emergency Response Plan may include:

- New information becomes available following an incident, near miss or hazard
- Learnings from an exercise or drill
- Change in contractor undertaking the work
- Organisational changes
- Changes to government agency contact details or portfolios

#### 8.5 Management of Change

The SMS establishes the processes required to ensure that when changes are made to a project, control systems, an organisational structure or to personnel, the EHS risks and other impacts of such changes are identified and appropriately managed.

The SMS requires that all environmentally relevant changes must obtain environmental approval (internal i.e. within Santos and/or external i.e. regulatory) prior to undertaking any activity.

Environmentally relevant changes include:

a) new activities, assets, equipment, processes or procedures proposed to be undertaken or implemented that have potential to impact on the environment and have not been:

- assessed for environmental impact previously, in accordance with the requirements of the standard; and
- authorised in the existing management plans, procedures, work instructions, or maintenance plans.

b) proposed changes to activities, assets, equipment, processes or procedures that have potential to impact the environment or interface with an environmental receptor.

c) changes to requirements of an existing external approval (e.g. changes to conditions of environmental licence).

d) new information or changes of information from research, stakeholders, legal and other requirements, and any other sources used to inform the EMP.

Where an environmentally relevant change is identified, the MoC is assessed by an Environmental Adviser and if required appropriate technical and/or legal advice is sought. The MoC assessment is

made against the approved EMP to ensure that impacts and risks from the change can be managed to ALARP and acceptable levels.

In the event that the proposed change is a significant modification or new stage of activity, introduces a significant new environmental impact or risk, results in a significant increase to an existing environmental impact or risk, or, as a cumulative effect results in an increase in environmental impact or risk, this EMP will be revised and submitted for re-assessment and acceptance by the regulator.

Section 1.2 details the permit titleholder, activity nominated liaison person and contact details for both. A change in any of these details are required to be notified to DPIR.

### 8.6 Incident Reporting

Incidents that impact on the environment or have the potential to impact on the environment (near-miss) are to be reported and entered into the EHS Toolbox Incident Management System (IMS).

Table 8-2 details the external incident notification, reporting requirements and timeframes for environmental incidents associated with the activity.

**Table 8-2 Incident Reporting Requirements**

Requirements	How and By When
<b>Recordable Incident Reporting</b>	
A recordable incident is a breach of an Environmental Objective or Environmental Performance Standard in the Environment Management Plan that applies to the activity; and is not a reportable incident.	Submit written report to DPIR ( <a href="mailto:petroleum.operations@nt.gov.au">petroleum.operations@nt.gov.au</a> ) within 15 days after the end of the reporting period.
The recordable incident report must contain: (i) a record of all recordable incidents that occurred during the reporting period; and (ii) all material facts and circumstances concerning the recordable incidents that the operator knows or is able, by reasonable search or enquiry, to find out; and (iii) any action taken to avoid or mitigate any adverse environment impacts of the recordable incidents; and (iv) the corrective action that has been taken, or is proposed to be taken, to prevent similar recordable incidents	
<b>Reportable Incident Reporting</b>	
A reportable incident is an incident relating to the activity that has caused, or has the potential to cause material or serious environmental harm as defined under the <i>Petroleum Act</i> . Based on the Santos Risk Matrix this is an incident that has an actual or potential consequence ≥ III. Incidents should also be reported to NT DPIR if it has been reported to another government department or agency or there is the potential for media or stakeholder interest.	The initial verbal report will be made as soon practicable but no later than 2 hours after the incident first occurred or when Santos became aware of the reportable incident to the DPIR Operations Team Emergency Number (1300 935 250) or in writing.
The <b>initial verbal report</b> will include as much preliminary information as is available about the incident (e.g. interest holder, location, type of incident, affected stakeholders, initial assessment of environmental harm and initial response).	

<p>The initial written report will include:</p> <ol style="list-style-type: none"> <li>a) The results of any assessment or investigation of the conditions or circumstances that caused or contributed to the occurrence of the reportable incident, including an assessment of the effectiveness of the designs, equipment, procedures and management systems that were in place to prevent the occurrence of an incident of that nature;</li> <li>b) the nature and extent of the material environmental harm or serious environmental harm that the incident caused or had the potential to cause;</li> <li>c) any actions taken, or proposed to be taken, to clean up or rehabilitate an area affected by the incident;</li> <li>d) any actions taken, or proposed to be taken, to prevent a recurrence of an incident of a similar nature.</li> </ol>	<p>The initial written report will be provided as soon as practicable but not later than 3 days after the reportable incident first occurs.</p>
<p>Interim reports will include:</p> <ol style="list-style-type: none"> <li>a) The results of any assessment or investigation of the conditions or circumstances that caused or contributed to the occurrence of the reportable incident, including an assessment of the effectiveness of the designs, equipment, procedures and management systems that were in place to prevent the occurrence of an incident of that nature;</li> <li>b) the nature and extent of the material environmental harm or serious environmental harm that the incident caused or had the potential to cause;</li> <li>c) any actions taken, or proposed to be taken, to clean up or rehabilitate an area affected by the incident;</li> <li>d) any other matters relevant to the reportable incident.</li> </ol>	<p>Interim reports to be provided as agreed with the Minister or at intervals of 90 days, starting on the day the initial report was given.</p>
<p>The <b>final reportable incident report</b> must include a root cause analysis of the reportable incident.</p>	<p>The final report to be provided to the Minister as soon as practicable but no later than 30 days after the clean up or rehabilitation of the area affected by the reportable incident is completed.</p>

## 8.7 Environmental Performance Monitoring and Reporting

### 8.7.1 Record Management

Key records for management relating to the activity include:

- Weed washdown records
- Induction records
- Photopoint records
- Records related to audits / inspections
- Records relating to investigation of incidents and noncompliance's..

SMS Information and Information Systems detail the requirements to ensure that information is kept current and accurate, stored in a manner to facilitate retrieval, and is accessible to personnel who need it.

Document control and record keeping requirements including record retention periods are specified in the SMS. Where no record retention requirement is specified, the default for physical records is 10 years and 'life of plant' for electronic records.

### 8.7.2 Audit

To ensure that the EMP requirements have been effectively implemented and that the performance outcomes and standards in the EMP have been met a desktop review – to ensure the EMP requirements have been appropriately communicated to relevant personnel as per Section 8.2 and procedures are in place to ensure EMP commitments can be met.

Audit / review findings including actions are communicated to the Santos and Contractor Project Managers and Santos Field Representative. Actions are agreed with all parties and assigned an actioner and required completion date. The audit and actions are recorded in the Santos EHS Toolbox Audit & Compliance Manager which notifies the actioner and their manager when actions are due. If actions are not closed within the due date the system has a hierarchy notification system based on the number of days an action is overdue as to the level of manager who receive notification of the overdue action.

### 8.7.3 Management of Non-Conformances

For the activity, a non-conformance is classed as:

- A breach of an environmental performance outcome or environmental performance standard (Section 7). This triggers the requirement to report as a "recordable incident" as per Section 8.6.
- Failure to implement a requirement in the implementation strategy.

Non-conformances are identified via:

- Audits and inspections
- Incident reporting and investigations
- Preparation of the Performance Report

Where a non-conformance is identified, actions are implemented to correct the non-conformance and prevent reoccurrence.

To ensure that non-conformances lead to learning and improvements for the activity and on a company-wide basis, non-conformance are:

- Communicated to the NT Exploration Manager via Santos EHS Toolbox (see below), daily and weekly meetings and the appropriate reports (i.e. audit, performance, incident investigation) to ensure personnel are made aware of non-conformances and corrective actions to help prevent recurrence of similar incidents.
- Communicated to operational personnel at daily pre-start meetings via the Santos Field Supervisor to ensure personnel are made aware of non-conformances and corrective actions to help prevent recurrence of similar incidents.
- Communicated internally within Santos as per the Santos Internal Incident Notification Guide and where there are lessons learnt that are applicable to other areas of the business a Flash Notification is issued.



- Recorded in Santos EHS Toolbox and actions tracked to completion.
- Reviewed by the actioner's manager prior to being closed to ensure actions are completed and implemented.
- Reported externally as per the requirements as detailed in Section 8.6.

#### **8.7.4 Routine reporting**

In accordance with Reg 11 (1), Santos will submit an annual report to DPIR which provides sufficient information to enable the regulator to determine that the environmental performance outcomes and standards in the EMP have been met. Given the limited scope of the activity, this will be a brief report outlining that all activities were undertaken in accordance with the EMP's environmental performance outcomes and standards. Should there be any exceptions to this, the report will provide further detail to the regulators requirements.

## 9.0 STAKEHOLDER ENGAGEMENT

Santos is committed to upholding its long-held reputation as a trusted Australian energy company. Santos seeks to establish and maintain enduring and mutually beneficial relationships with the communities of which it is a part; ensuring that Santos' activities generate positive economic and social benefits for and in partnership with these communities.

The Santos Management System (SMS) details the requirements for appropriate communication and consultation mechanisms. The standard includes requirements to establish and maintain communication links with employees, contractors and external stakeholders, including local communities, government agencies and other organisations. Reporting and notification of EHS incidents to the appropriate government agency occurs as required.

Santos QNT Pty Ltd has continued to engage with key stakeholders on an ongoing basis since completion of the drilling and partial rehabilitation works at Tanumbirini 1. Contact has been maintained as per the Land Access Compensation Agreement (LACA) \*\*Text Redacted\*\*

\*\*Text Redacted\*\*

Ongoing consultation and contact has been via \*\*Text Redacted\*\*, manager of Tanumbirini Station. Conversations with and other stakeholders is provided in Appendix 5

.

\*\*Text Redacted\*\*

### 9.1 Ongoing Consultation

Prior to any land access a notice of entry is issued to the landholder. Santos will not access any person's land without prior consent in the form of a written agreement and in accordance with the DPIR policies and guidelines.

Where stakeholders have requested or Santos believes it would be beneficial to engage with stakeholders on an ongoing basis during the activity, communications will continue until the activity has concluded.

Project specific consultation has centred on:

- Vertical Seismic Profile (VSP) 2018 Enabling Activity – Beetaloo Basin meeting conducted in Darwin, 16 July 2018

Attendees:

- \*\*Text Redacted\*\*
- \*\*Text Redacted\*\*
- \*\*Text Redacted\*\*
- \*\*Text Redacted\*\*
- \*\*Text Redacted\*\*

Site visit between the 8th August during phase 1 of the baseline weed assessment and methane monitoring

Attendees:

- \*\*Text Redacted\*\*
- \*\*Text Redacted\*\*

Meeting the DPIR to discuss this water bore monitoring EMP 27 September 2018

Attendees:

- \*\*Text Redacted\*\*

Discussions with representatives of DENR and DPIR will continue on an ongoing basis throughout the lifetime of activities on EP 161.

Santos has also recently briefed the Barkly Regional Council and the Tennant Creek Regional Development Committee about the anticipated exploration program and management of environmental impacts.

Santos has been actively engaged with the Pepper Inquiry and its subsequent implementation process – providing detailed information to the Inquiry drawing from our existing knowledge of the Beetaloo region, the initial exploration activities that have occurred there and our extensive experience in gas exploration. Santos engages regularly with senior officials of the Departments of Chief Minister, Primary Industries and Resources and Environment and Natural Resources to advance the implementation of the 135 recommendations of the Pepper Inquiry.

Santos has agreed to support and contribute to the funding of the GISERA research which is being undertaken to support the development of a SREBA for the Beetaloo. We have provided the DENR with access to our existing groundwater monitoring data collected by CSIRO on our behalf over recent years, and have facilitated initial survey work by CSIRO for methane and in collaboration with DENR for weed monitoring. Santos is committed to the timely release of information from these research processes to ensure that all stakeholders are fully informed about the true state of the environment in the exploration area, and any impacts should they occur.

## 10.0 REFERENCES

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- Department of Environment and Energy (DoEE) (2018). *Protected Matters Search Tool*. Available from <https://www.environment.gov.au/epbc/protected-matters-search-tool>. Accessed 24 September 2018.
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- Department of Tourism and Culture (2018) NT Heritage Database, accessed 4 April 2018. Available from [http://www.ntlis.nt.gov.au/heritageregister/?p=103:301:1533285573598972::NO::P301\\_SPATIAL:N](http://www.ntlis.nt.gov.au/heritageregister/?p=103:301:1533285573598972::NO::P301_SPATIAL:N)
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- Northern Territory Government (2018). NRM InfoNet. Accessed 24 September 2018. Available from <http://www.ntinonet.org.au/infonet2/>

## **Appendix 1: EPBC Act Protected Matters Search Report**



# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/09/18 15:40:11

[Summary](#)

[Details](#)

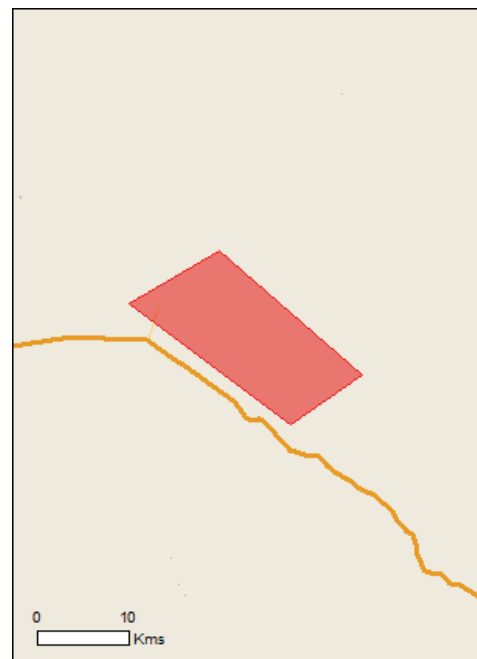
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are  
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[Coordinates](#)

Buffer: 10.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	None
<a href="#">Listed Threatened Species:</a>	11
<a href="#">Listed Migratory Species:</a>	12

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	None
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	19
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">State and Territory Reserves:</a>	None
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	11
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None



# Details

## Matters of National Environmental Significance

Listed Threatened Species		[ Resource Information ]
Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Erythrotriorchis radiatus</a> Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Erythrura gouldiae</a> Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
<a href="#">Falcunculus frontatus whitei</a> Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Rostratula australis</a> Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
<a href="#">Tyto novaehollandiae kimberli</a> Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
<b>Mammals</b>		
<a href="#">Macroderma gigas</a> Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Macrotis lagotis</a> Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Pseudantechinus mimulus</a> Carpentarian Antechinus [59283]	Vulnerable	Species or species habitat known to occur within area
<a href="#">Saccolaimus saccolaimus nudicluniatus</a> Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Elseya lavarackorum</a> Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area

Listed Migratory Species		[ Resource Information ]
Name	Threatened	Type of Presence
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		

Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a>		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<b>Migratory Terrestrial Species</b>		
<a href="#">Cecropis daurica</a>		
Red-rumped Swallow [80610]		Species or species habitat may occur within area
<a href="#">Cuculus optatus</a>		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
<a href="#">Hirundo rustica</a>		
Barn Swallow [662]		Species or species habitat may occur within area
<a href="#">Motacilla cinerea</a>		
Grey Wagtail [642]		Species or species habitat may occur within area
<a href="#">Motacilla flava</a>		
Yellow Wagtail [644]		Species or species habitat may occur within area

<b>Migratory Wetlands Species</b>		
<a href="#">Actitis hypoleucos</a>		
Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a>		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a>		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a>		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Charadrius veredus</a>		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
<a href="#">Glaucous-winged Gull</a>		
Oriental Pratincole [840]		Species or species habitat may occur within area

## Other Matters Protected by the EPBC Act

Listed Marine Species		[ <a href="#">Resource Information</a> ]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Actitis hypoleucos</a>		
Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Anseranas semipalmata</a>		
Magpie Goose [978]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a>		
Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		habitat likely to occur within area  Species or species habitat likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Charadrius veredus</a> Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
<a href="#">Chrysococcyx osculans</a> Black-eared Cuckoo [705]		Species or species habitat may occur within area
<a href="#">Glareola maldivarum</a> Oriental Pratincole [840]		Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
<a href="#">Hirundo daurica</a> Red-rumped Swallow [59480]		Species or species habitat may occur within area
<a href="#">Hirundo rustica</a> Barn Swallow [662]		Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area
<a href="#">Motacilla flava</a> Yellow Wagtail [644]		Species or species habitat may occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Crocodylus johnstoni</a> Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

## Extra Information

### Invasive Species [\[ Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
<b>Birds</b>		
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
<b>Frogs</b>		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
<b>Mammals</b>		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
<b>Plants</b>		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species

Name	Status	Type of Presence
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		habitat may occur within area  Species or species habitat likely to occur within area

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-16.51547 134.84181,-16.56121 134.77303,-16.44779 134.61511,-16.39877 134.70324,-16.51547 134.84181

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

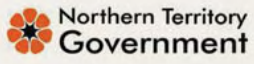
- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

**Appendix 2: NT NRM Report**





# Custom area

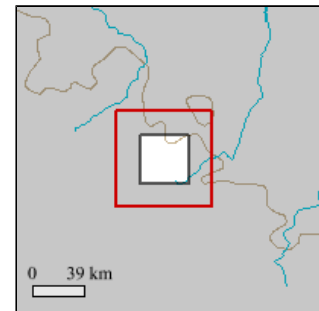
*NT NRM Report*



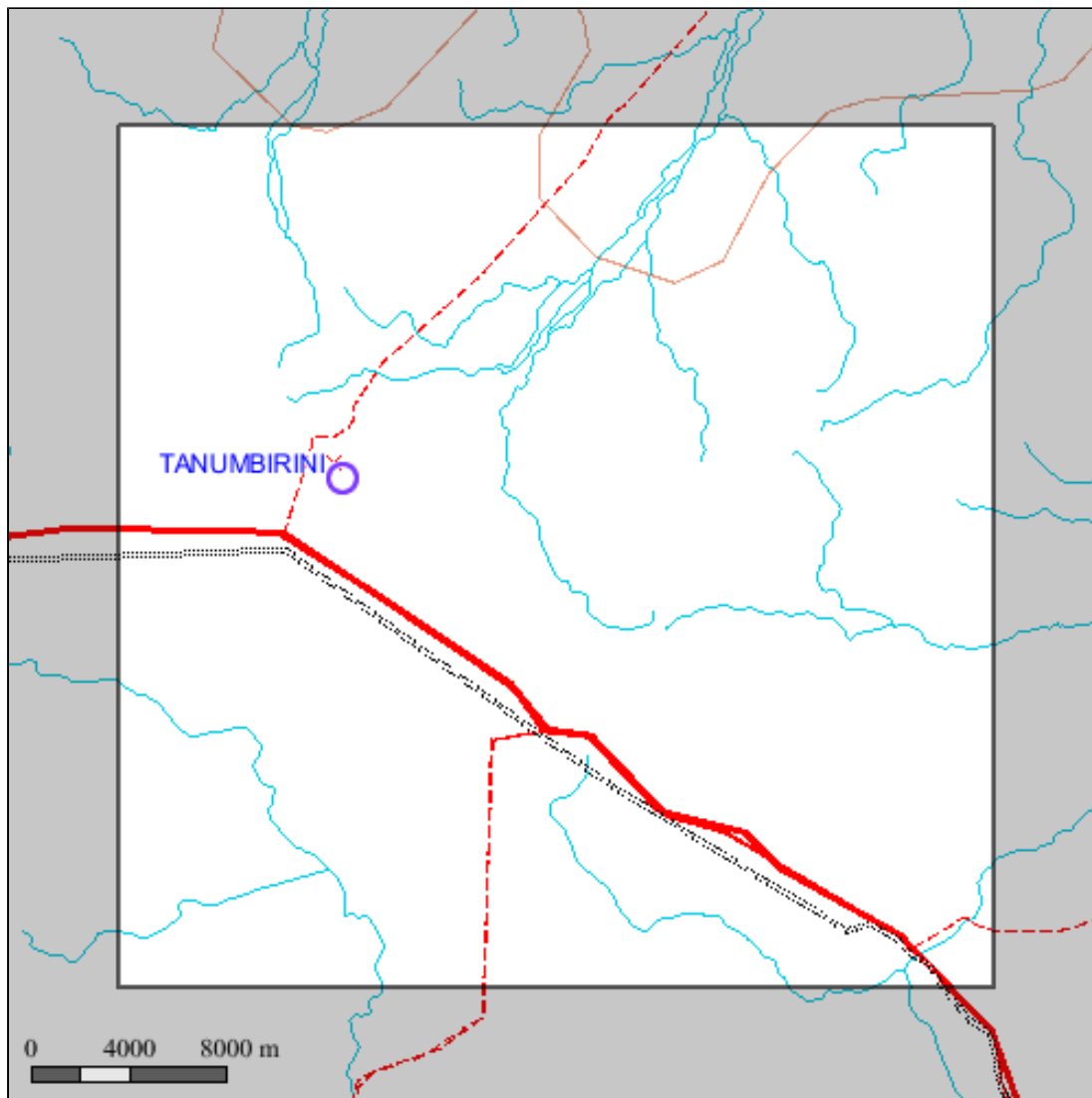
# Custom area

Custom area encompasses an area of 1192.33 sq km extending from 16 deg 20.0 min to 16 deg 38.0 min S and 134 deg 34.0 min to 134 deg 53.0 min E.

Custom area is located in the Gulf Fall and Uplands, Sturt Plateau, bioregion(s)



Location of Custom area



# Custom area Climate

The closest long-term weather station is MCARTHUR RIVER MINE (16 deg 26.0 min S, 136.076E) 143 km E of the center of selected area

## Statistics

Mean max temp (deg C)  
 Mean min temp (deg C)  
 Average rainfall (mm)  
 Average days of rain

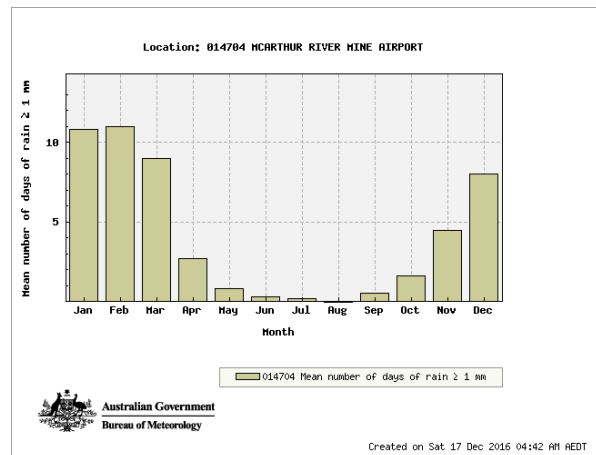
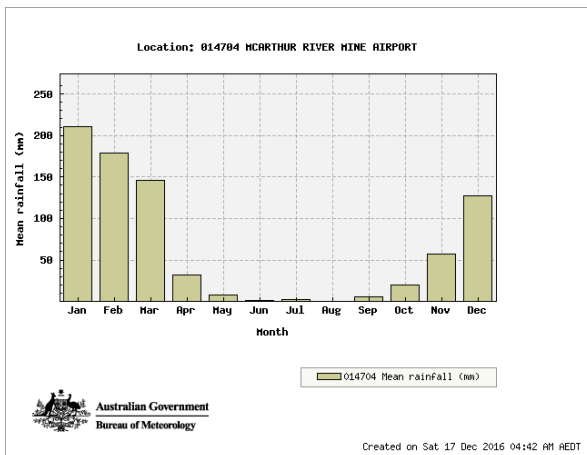
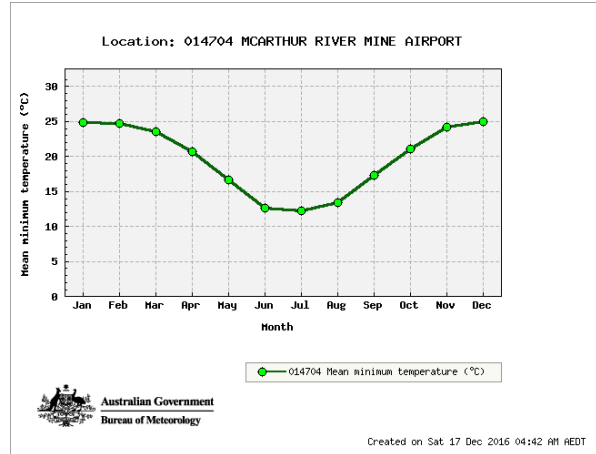
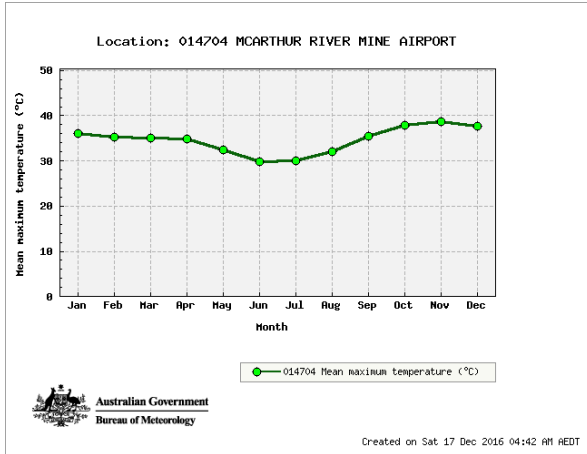
## Annual Values

34.6  
 19.7  
 766.1  
 49.4

## Years of record

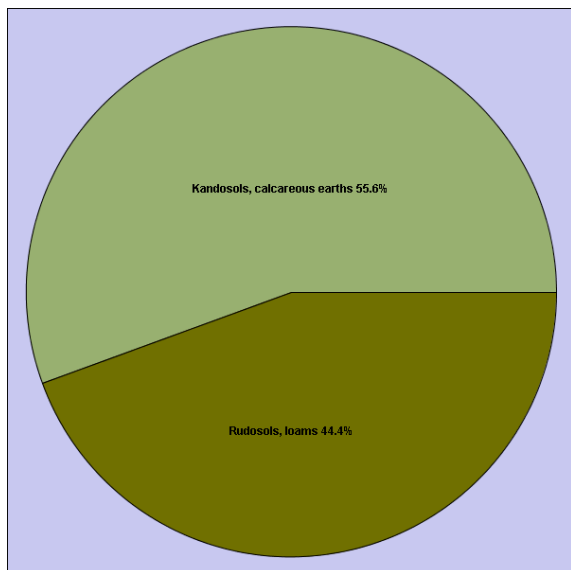
39  
 39  
 38  
 45

Climate summaries from Bureau of Meteorology ([www.bom.gov.au](http://www.bom.gov.au))



# Custom area Soils

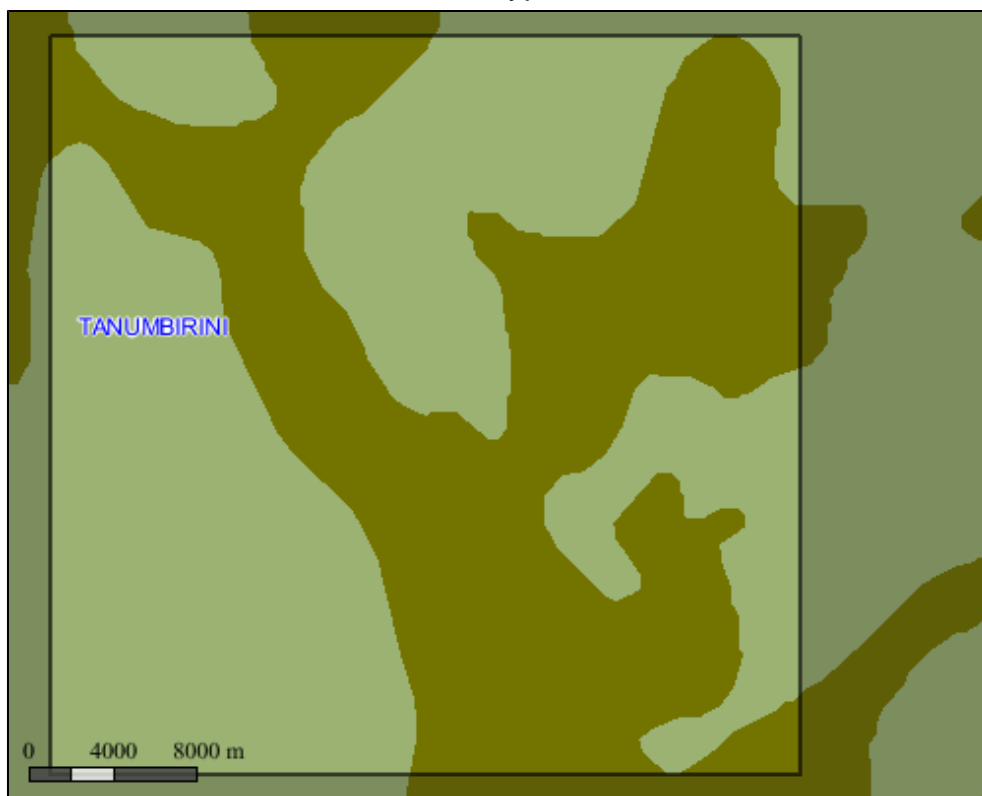
## Soil Types



## Area of soil types (Northcote Factual Key)

Category	Area sq km	Area%
Kandosols, calcareous earths	662.77	55.59
Rudosols, loams	529.56	44.41

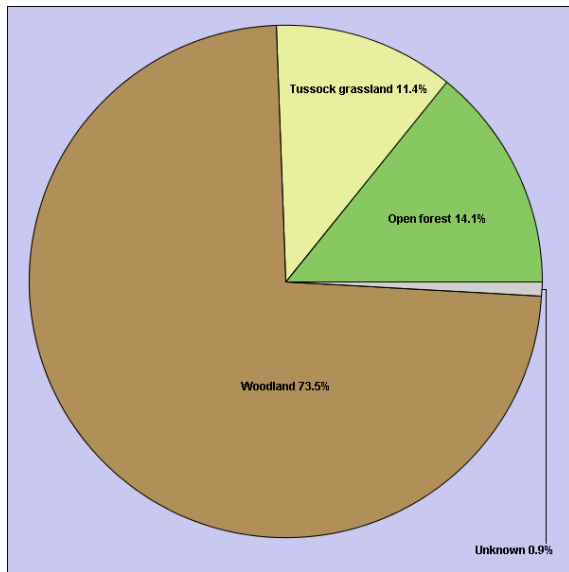
## Soil Types



Soils 1:2M Layer is a copy of the NT portion (1:2,000,000 scale dataset) of the CSIRO Atlas of Australian Soils - K.H. Northcote et al. Data scale: 1:2,000,000 ANZLIC Identifier: 2DBC771205D06B6E040CD9B0F274EFE  
More details: Go to [www.lrm.nt.gov.au/nrmapsnt/](http://www.lrm.nt.gov.au/nrmapsnt/) and enter the ANZLIC identifier in the Spatial Data Search

# Custom area Vegetation

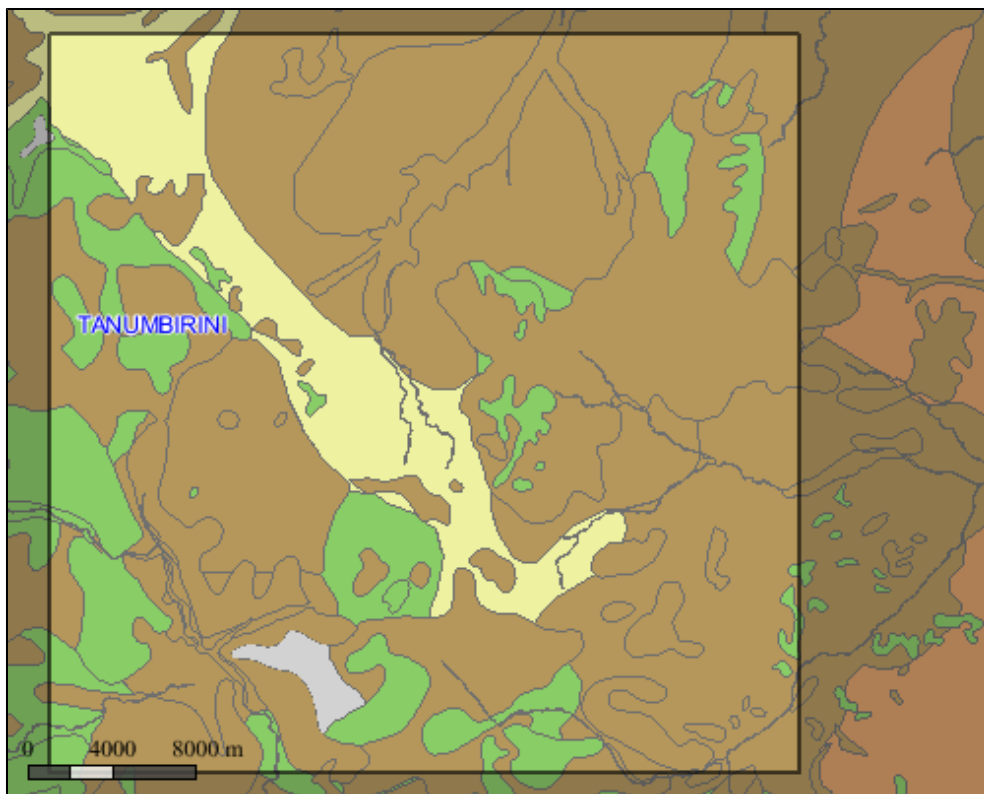
## Vegetation Communities



## Area of vegetation communities

Category	Area sq km	Area%
Woodland	876.81	73.54
Open forest	168.52	14.13
Tussock grassland	136.47	11.45
Unknown	10.53	.88

## Vegetation Communities

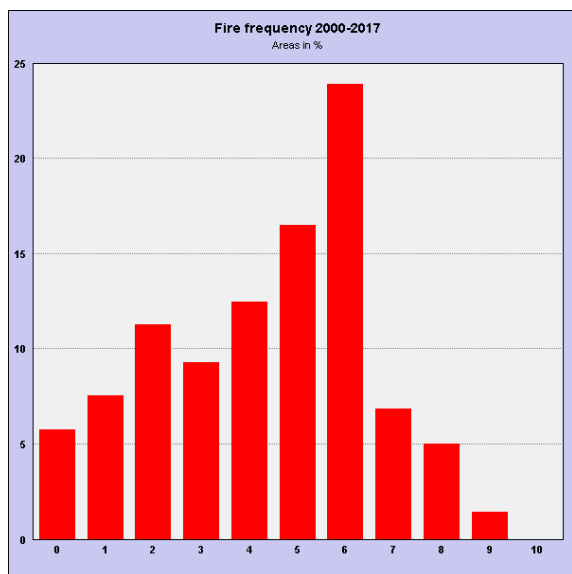


The NVIS 2005 Layer is compiled from a number of vegetation and land unit survey maps that were recoded and re-attributed for the National Vegetation Information System (NVIS)

Data scale variable depending on location. ANZLIC Identifier:2DBC771207006B6E040CD9B0F274EFE  
More details:Go to [www.lrm.nt.gov.au/nrmapsnt/](http://www.lrm.nt.gov.au/nrmapsnt/) and enter the ANZLIC identifier in the Spatial Data Search

# Custom area Fire History

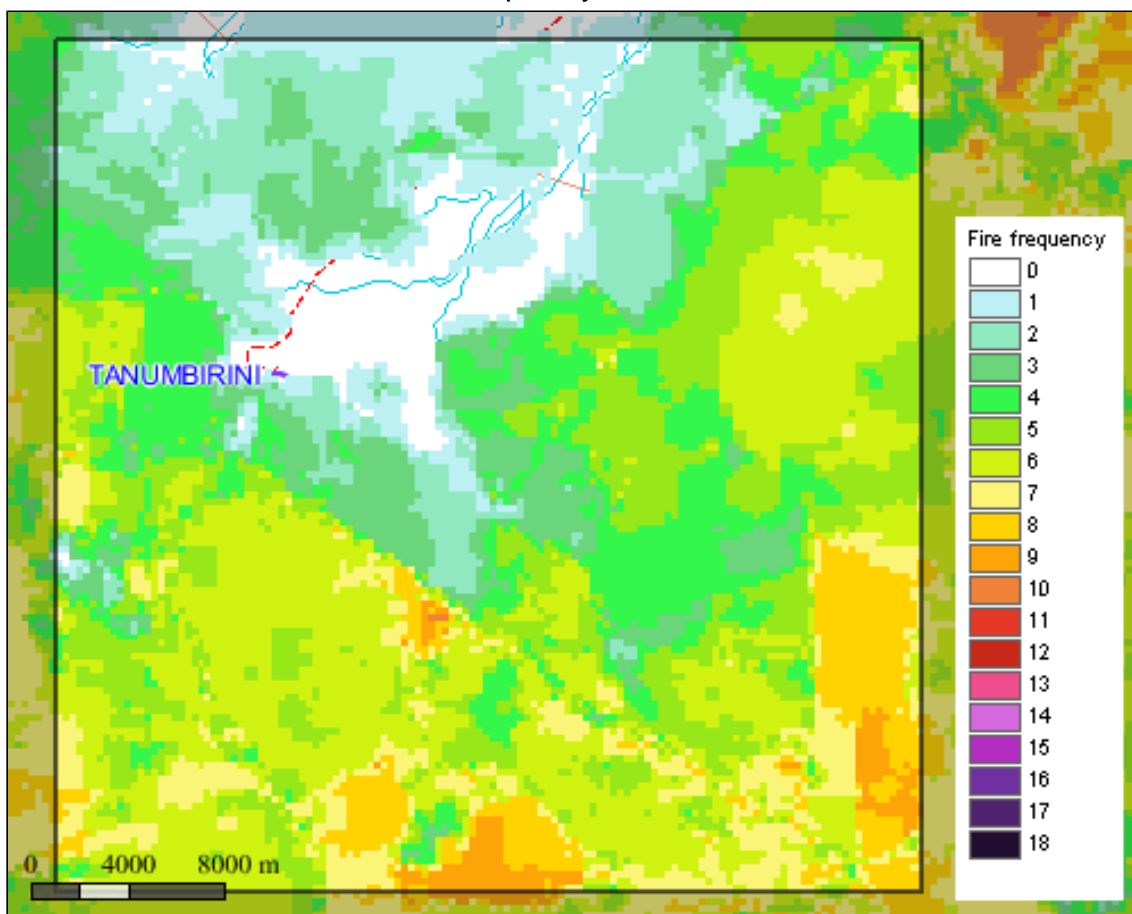
Fire frequency 2000-2017



area burnt for each fire frequency category 2000-2017

Category	Area sq km	Area%
0	68.56	5.75
1	90.01	7.55
2	134.37	11.27
3	110.63	9.28
4	148.46	12.45
5	196.71	16.50
6	284.77	23.88
7	81.97	6.87
8	59.71	5.01
9	16.91	1.42
10	.23	.02

Fire frequency 2000-2017



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite  
Spatial Resolution: 250m x 250m pixels (at Nadir).

# Custom area Threatened Species



Threatened species recorded in Custom area (Records Updated: Sept 2013)

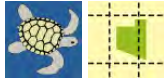
Group	Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Reptiles	Mertens` Water Monitor	<i>Varanus mertensi</i>	VU	.	347295	2 (1993)	0 (Unknown)	1 (1993)

EX = Extinct  
 EW = Extinct in the Wild  
 ER = Extinct in the NT  
 EN = Endangered  
 EN/VU = One Endangered subspecies/One Vulnerable subspecies  
 VU=Vulnerable  
 VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology  
 Specimen = this category refers to museum or other records where a specimen has been collected and lodged  
 Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=####](http://www.landmanager.org.au/view/index.aspx?id=####)  
 where #### is the ID number from the tables above for the species of interest.

# Custom area Threatened Species Grid



Threatened species recorded in the grid cell(s) in which Custom area occurs (Records Updated: Sept 2013)

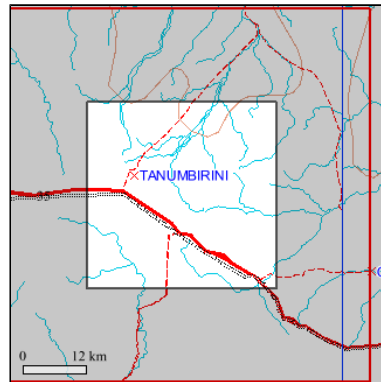
Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	Latest Observation Date	#Specimens	Latest Specimen Date	#Surveys	Latest Survey Record
Reptiles	Varanidae	<i>Varanus mertensi</i>	Mertens' Water Monitor	VU		3	1993	0	Unknown	1	1993
Mammals	Dasyuridae	<i>Pseudantechinus mimulus</i>	Carpentarian Antechinus		VU	0	Unknown	1	1987	0	Unknown

EX = Extinct  
 EW = Extinct in the Wild  
 ER = Extinct in the NT  
 EN = Endangered  
 EN/VU = One Endangered subspecies/One Vulnerable subspecies  
 VU = Vulnerable  
 VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology  
 Specimen = this category refers to museum or other records where a specimen has been collected and lodged  
 Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=####](http://www.landmanager.org.au/view/index.aspx?id=####)  
 where #### is the ID number from the tables above for the species of interest.

Species listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area





# Custom area Weeds and Potential Weeds



Introduced plants recorded in the grid cell(s) in which Custom area occurs and that have been identified as problem weeds in one or more locations in northern Australia. Occurrence based on Northern Territory Government databases.

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Poaceae	<i>Cenchrus ciliaris</i>	Buffel Grass			MP Gr G&M DEU	0	Unknown
Cucurbitaceae	<i>Cucumis melo</i>	Ulcardo Melon			DEU	5	1991
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass			DEU	2	1991
Fabaceae	<i>Macroptilium atropurpureum</i>	Siratro			C&E	0	Unknown
Malvaceae	<i>Malvastrum americanum</i>	Spiked Malvastrum			DEU	1	1988
Plantaginaceae	<i>Scoparia dulcis</i>	Bitter Broom			DEU	0	Unknown
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	B C		MP G&M DEU	0	Unknown
Malvaceae	<i>Sida spinosa</i>	Spiny Sida			DEU	0	Unknown
Fabaceae	<i>Stylosanthes hamata</i>	Caribbean Stylo			DEU	0	Unknown
Poaceae	<i>Urochloa mosambicensis</i>	Sabi Grass			DEU	0	Unknown
Asteraceae	<i>Xanthium strumarium</i>	Noogoora Burr	B C		MP WA1 WA2 WA4 DEU NSW SA	0	Unknown

#### Status Codes:

##### 1. NATIONAL STATUS CODES

Alert, Alert List for Environmental Weeds (Please call Exotic Plant Pest Hotline 1800 084 881 if you think you have seen this weed)

Sleeper, National Sleeper Weed

Target, Targeted for eradication. ([www.landmanager.com.au/view/index.aspx?id=449837](http://www.landmanager.com.au/view/index.aspx?id=449837))

WONS, Weeds of National Significance

##### 2. NT STATUS CODES

A, NT Class A Weed (to be eradicated)

B, NT Class B Weed (growth & spread to be controlled)

C, NT Class C Weed (not to be introduced) ([www.landmanager.com.au/view/index.aspx?id=449869](http://www.landmanager.com.au/view/index.aspx?id=449869))

##### 3. OTHER STATUS CODES

C&E, Csurhes, S. & Edwards, R. (1998) Potential Environmental Weeds in Australia. Candidate Species for Preventative Control. Environment Australia, Canberra ([www.landmanager.com.au/view/index.aspx?id=394504](http://www.landmanager.com.au/view/index.aspx?id=394504))

CYP, Draft Cape York Peninsula Pest Management Plan 2006-2011 ([www.landmanager.com.au/view/index.aspx?id=371200](http://www.landmanager.com.au/view/index.aspx?id=371200))

DEU, Plants listed as environmental weeds by the Desert Uplands Strategic Land Resource

Assessment ([www.landmanager.com.au/view/index.aspx?id=332123](http://www.landmanager.com.au/view/index.aspx?id=332123))

G&M, Grice AC, Martin TG. 2005. The Management of Weeds and Their Impact on Biodiversity in the Rangelands. Cooperative Research Centre (CRC) for Australian Weed Management and CSIRO Sustainable Ecosystems. Commonwealth Australia ([www.landmanager.com.au/view/index.aspx?id=163572](http://www.landmanager.com.au/view/index.aspx?id=163572))

Gr, Groves et al. 2003. Weed categories for natural and agricultural ecosystem management. Bureau of Rural Sciences ([www.landmanager.com.au/view/index.aspx?id=388018](http://www.landmanager.com.au/view/index.aspx?id=388018))

K0, High Priority Weeds not yet established in the Katherine region

K1, High Priority Weeds posing environmental threats in the Katherine region

K2, High Priority Weeds posing existing threats in the Katherine region, as described in the Katherine Regional Weed Management Strategy 2005-2010 ([www.landmanager.com.au/view/index.aspx?id=130286](http://www.landmanager.com.au/view/index.aspx?id=130286))

MP, Northern Territory Parks & Conservation Masterplan ([www.landmanager.com.au/view/index.aspx?id=144141](http://www.landmanager.com.au/view/index.aspx?id=144141))

NAQS, North Australian Quarantine Strategy Target List ([www.landmanager.com.au/view/index.aspx?id=449416](http://www.landmanager.com.au/view/index.aspx?id=449416))

NSW, Declared Noxious Weed in NSW ([www.landmanager.com.au/view/index.aspx?id=449983](http://www.landmanager.com.au/view/index.aspx?id=449983))

Q1, QLD Class 1 Weed (not to be introduced, kept or supplied-

Q2, Class 2 Weed (eradicate where possible, not to be introduced, kept or supplied)

Q3, Qld Class 3 Weed (to be controlled near environmentally sensitive areas- not to be supplied/sold without a permit) ([www.landmanager.com.au/view/index.aspx?id=190714](http://www.landmanager.com.au/view/index.aspx?id=190714))

SA, Declared Plant in South Australia ([www.landmanager.com.au/view/index.aspx?id=449996](http://www.landmanager.com.au/view/index.aspx?id=449996))

WeedsAus, Listed as a significant weed by Weeds Australia ([www.landmanager.com.au/view/index.aspx?id=14576](http://www.landmanager.com.au/view/index.aspx?id=14576))

WA1, WA Weed Class P1 (movement prohibited)

WA2, WA Weed Class P2 (aim to eradicate)

WA3, WA Weed Class P3 (control infestations)  
WA4, WA Weed Class P4 (prevent spread)  
WA5, WA Weed Class P3 (control infestations on public land) ([www.landmanager.com.au/view/index.aspx?id=449884](http://www.landmanager.com.au/view/index.aspx?id=449884)).

Survey = this category refers to data collected using systematic survey methodology  
Specimen = this category refers to museum or other records where a specimen has been collected and lodged  
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=###](http://www.landmanager.org.au/view/index.aspx?id=###)  
where ### is the ID number from the tables above for the species of interest.

Plants listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area

---

# Custom area Pest and Potential Pest Animals



Animals with pest potential recorded in the grid cell(s) in which Custom area occurs. Occurrence based on Northern Territory Government databases.

Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Cane Toad	<i>Rhinella marina</i>	P	.	183252	1 (2001)	0 (Unknown)	1 (1993)
Red-tailed Black-cockatoo	<i>Calyptorhynchus banksii macrorhynchus</i>	N	.	223765	14 (2001)	0 (Unknown)	0 (Unknown)
Agile Wallaby	<i>Macropus agilis</i>	N	.	223786	2 (1987)	1 (1996)	0 (Unknown)
Dingo / Wild dog	<i>Canis lupus</i>	N	.	183280	1 (1987)	0 (Unknown)	1 (1993)
Horse	<i>Equus caballus</i>	P	.	183315	1 (1987)	0 (Unknown)	0 (Unknown)
Cattle	<i>Bos taurus</i>	P	.	183266	1 (1987)	0 (Unknown)	2 (1993)

#### NT STATUS CODES:

Int, Introduced species (all non-prohibited vertebrates, and all other exotic species ([www.landmanager.com.au/view/index.aspx?id=280771](http://www.landmanager.com.au/view/index.aspx?id=280771)))

N, Native species with pest potential.

P, Prohibited species (all exotic vertebrates except those listed as non-prohibited ([www.landmanager.com.au/view/index.aspx?id=450509](http://www.landmanager.com.au/view/index.aspx?id=450509)))

Survey = this category refers to data collected using systematic survey methodology

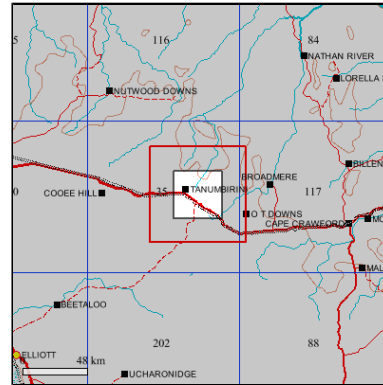
Specimen = this category refers to museum or other records where a specimen has been collected and lodged

Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=####](http://www.landmanager.org.au/view/index.aspx?id=####)

where #### is the ID number from the tables above for the species of interest.

Potential pest animals listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



Soils and vegetation graphs and tables refer to area of soils and vegetation only. Fire graphs and tables refer to entire selected area including sea if present. Calculations are derived from map images or vector data, and should be taken as a guide only. Accuracy cannot be guaranteed. For small areas, figures should be rounded to the nearest whole number.

Fire map layers used in these reports have been updated in 2018 so their pixels are aligned to the same grid.

## **Appendix 3 Ecological Assessment Report**





# Ecology report EP161 Work Program 2018 Santos



# DOCUMENT CONTROL RECORD

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<b>Document ID</b>	169705-30
<b>Author(s)</b>	Nicole Clark, Aiden Campbell

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EcOz Pty Ltd.  
ABN: 81 143 989 039  
Winlow House, 3<sup>rd</sup> Floor  
75 Woods Street  
DARWIN NT 0800  
GPO Box 381, Darwin NT 0800

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



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# TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
1.1	Purpose and scope .....	1
<b>2</b>	<b>EXPLORATION PROGRAM FOOTPRINT</b> .....	<b>2</b>
<b>3</b>	<b>WEED SURVEY</b> .....	<b>4</b>
3.1	Background .....	4
3.2	Methods.....	5
3.3	Results .....	8
<b>4</b>	<b>THREATENED SPECIES HABITAT</b> .....	<b>11</b>
4.1	Background .....	11
4.2	Method .....	11
4.3	Results .....	12
4.3.1	VSP lines & Tanumbirini-2 .....	12
4.3.2	Tanumbirini-3 .....	15
4.3.3	Species records .....	17
<b>5</b>	<b>SENSITIVE VEGETATION</b> .....	<b>19</b>
5.1	Method .....	20
5.2	Results .....	20
<b>6</b>	<b>CONCLUSION &amp; RECOMMENDATIONS</b> .....	<b>23</b>
<b>7</b>	<b>REFERENCES</b> .....	<b>24</b>

## Tables

Table 3-1.	Potential declared weeds that may occur within the Project footprint .....	4
Table 3-2.	Priority weeds within the Katherine Region Weed Management Plan .....	5
Table 3-3.	Declared weed species .....	8
Table 4-1.	<i>E. leucophloia</i> habitat characteristics .....	14
Table 4-2.	Hollow counts for <i>E. leucophloia</i> within Tanumbirini-3 buffer .....	17

## Figures

Figure 2-1.	2018 exploration program footprint .....	3
Figure 3-1.	Map showing program footprint and survey tracks.....	7
Figure 3-2.	Photos of weeds identified during surveys .....	9
Figure 3-3.	Weed records within the Exploration program footprint and surrounds .....	10
Figure 4-1.	Location of <i>E. leucophloia</i> patches along VSP lines .....	13
Figure 4-2.	Photos showing vegetation within the Tanumbirini-3 buffer .....	16
Figure 4-3.	<i>E. leucophloia</i> trees within Tunambirini-3 survey area.....	18
Figure 5-1.	Riparian vegetation within the broader area.....	19
Figure 5-2.	Photos of riparian vegetation at VSP - watercourse intersections .....	21
Figure 5-3.	Map showing sites of potential sensitive vegetation within Exploration Program Footprint .....	22

# 1 INTRODUCTION

---

Santos is planning to undertake exploration works within their Exploration Permit area (EP161). The exploration works will potentially include drilling of two wells (Tanumbirini-2 and Tanumbirini-3) and vertical seismic profiling (VSP) radiating from Tanumbirini-2. Santos has an Environmental Management Plan (EMP) for the exploratory drilling program already conducted.

## 1.1 Purpose and scope

In 2017, EcOz Environmental Consultants (EcOz) prepared a desktop assessment of the biodiversity values within Santos' area of explorations (EcOz 2017). The desktop report provided a number of recommendations for Santos to consider when planning any further survey works. Principally, it was recommended that:

- Undertaking a weed survey at exploratory drilling and/or seismic exploration sites and along access tracks would provide baseline data. This would enable Santos to ensure that activities do not introduce or spread weeds.
- Prior to more intensive works being undertaken, it is recommended that further assessment of habitat for Gouldian Finch and potential impact to this species be undertaken. This would include desktop assessment and on-ground studies and would be assessed in relation to a project footprint.

Additionally, as the 2018 exploration activities have a long linear footprint (VSP lines) watercourses will be intersected. These watercourses may support sensitive vegetation in the form of riparian vegetation. Santos wanted the location of any sensitive vegetation to be identified so that potential impact to these communities could be minimise during exploration.

To address these recommendation during the planning for 2018 exploration program, Santos has engaged EcOz to complete surveys for:

- Listed weed species
- Threatened species habitat and incidental species observations
- Sensitive vegetation

The scope of the surveys is limited to the potential 2018 exploration program footprint – described in Section 2 - and were undertaken in August 2018. This report details the works undertaken and the results of the surveys for each scope area. Management considerations are also provided for Santos when undertaking their exploration work.

A primary Erosion and Sediment Control Plan (ESCP) is also be developed to be used for the exploration activities within EP161, that work is outside the scope of this report.

## 2 EXPLORATION PROGRAM FOOTPRINT

---

Santos is planning to undertake exploration works within their Exploration Permit area (EP161). The exploration works will potentially include drilling of two wells (Tanumbirini-2 and Tanumbirini-3) and vertical seismic profiling (VSP) radiating from Tanumbirini-2.

Tanumbirini-2 will be located within the existing Tanumbirini-1 lease area, which was drilled in 2014. Exploration activities are expected to occur within the existing disturbance footprint of Tanumbirini-1, however, may extend outside the previously disturbed area, but not more than 500 m from the well head. Tanumbirini-3 is located in a site not previously disturbed for gas exploration. Drilling of Tanumbirini-3 will involve clearing an area with a 500 m radius. A new access track from existing station roads will likely be required.

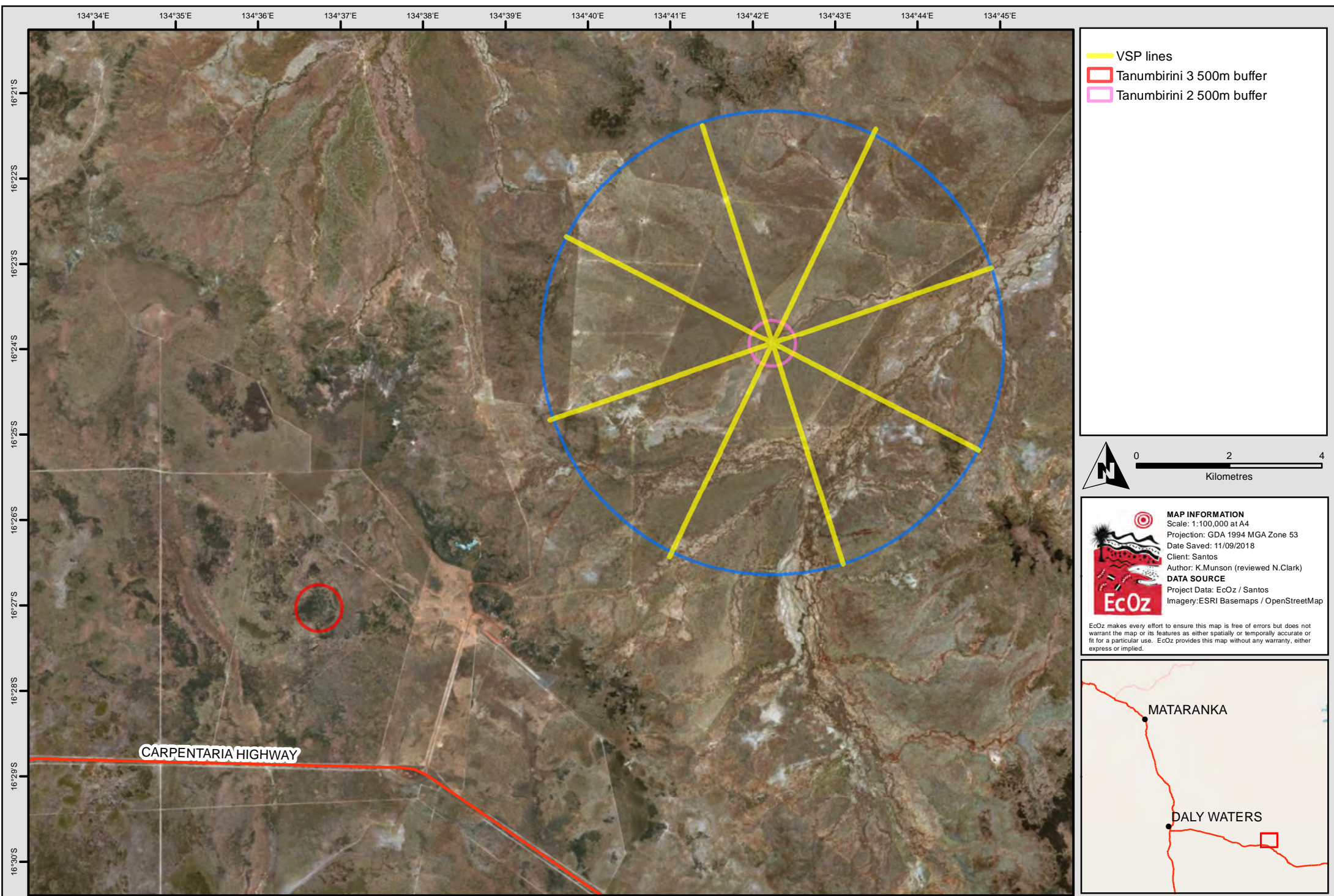
The proposed VSP program includes 40 km of VSP lines (eight lines each 5 km long). VSP will involve 2-3 small trucks with measurement instruments (hydrophone, geophone or similar) driving along the VSP lines and recording reflected seismic energy originating from an energy source. A tracked bulldozer, with blade up, will precede the seismic trucks to ensure passage. The bulldozer will avoid the majority of trees along the VSP lines but may remove obstacles such as termite mounds, understorey thicket, and reduce the approach angle for trucks at watercourse crossings. The bulldozer will remove only what is required for passage of trucks.

To ensure that the surveys capture the 2018 exploration program footprint, the survey footprint will include:

- A buffer of 500 m around each of the proposed well locations
- The VSP lines with a buffer of 5 m either side
- Likely station tracks used to access exploration areas
- Accessible stock watering points and fence lines.

The project footprint is shown in Figure 2-1.





Path: Z:\01 EcOz\_Documents\04 EcOz Vantage GIS\EZ18107 - Grants Project - Waste characterisation\01 Project Files\figure 2-1 program footprint.mxd

**Figure 2-1. 2018 exploration program footprint**

## 3 WEED SURVEY

This section provides context for and describes the weed surveys undertaken within the survey footprint.

### 3.1 Background

The weed surveys focused on the weeds that are of concern within the Katherine/Barkly Region.

There are three classes of weeds declared under the NT *Weeds Management Act* (some of which are also considered Weeds of National Significance (WoNS), categorised based on the risks of harm they can cause and how difficult they are to control. Those categories are:

- Class A – to be eradicated
- Class B – growth and spread to be controlled
- Class C – not to be introduced into the NT.

NT listed weeds identified within the region (NT Infonet search) are shown in (Table 3-1).

**Table 3-1. Potential declared weeds that may occur within the Project footprint**

Common name	Scientific name	NT Class	WoNS
Prickly Acacia	<i>Acacia nilotica</i>	A and C	Y
Starburr	<i>Acanthospermum hispidum</i>	B and C	
Mossman River Grass	<i>Cenchrus echinatus</i>	B and C	
Hyptis	<i>Hyptis suaveolens</i>	B and C	
Parkinsonia	<i>Parkinsonia aculeata</i>	B and C	Y
Spiny-head Sida	<i>Sida acuta</i>	B and C	
Flannel Weed	<i>Sida cordifolia</i>	B and C	
Paddy`s Lucerne	<i>Sida rhombifolia</i>	B and C	
Caltrop	<i>Tribulus terrestris</i>	B and C	
Noogoora Burr	<i>Xanthium strumarium</i>	B and C	
Parkinsonia	<i>Parkinsonia aculeata</i>	B and C	Y
Bellyache Bush	<i>Jatropha gossypifolia</i>	A and C <sup>1</sup>	Y
Mesquite	<i>Prosopis spp.</i>	A and C	Y
Khaki Weed	<i>Alternanthera pungens</i>	B and C	
Rubber Bush <sup>2</sup>	<i>Calotropis procera</i>	B and C	
Parthenium	<i>Parthenium hysterophorus</i>	A and C	Y

Program footprint is within the area covered by the Katherine Regional Weed Management Plan 2015-2020 (Weed Management Plan) (DLRM 2015). The Weed Management Plan identifies priority weeds within the region (Table 3-2).

<sup>1</sup> Bellyache bush listing depends on location within the NT, the exploration areas are within the Class A eradication zone.

<sup>2</sup> Note that although Rubber Bush is only declared south of 16°30' S, it was included in this area as current exploration areas are just north of this latitude and the exploration permit area crosses this line of declaration.



**Table 3-2. Priority weeds within the Katherine Region Weed Management Plan**

Common name	Scientific name	NT Class	WoNS
Mesquite	<i>Prosopis spp.</i>	A/C	Y
Prickly acacia	<i>Vachellia nilotica</i>	A/C	Y
Parkinsonia	<i>Parkinsonia aculeata</i>	B/C	Y
Chinee Apple	<i>Ziziphus mauritiana</i>	A/C	-
Mimosa	<i>Mimosa pigra</i>	A/C	Y
Bellyache Bush	<i>Jatropha gossypifolia</i>	A/C	Y
Gamba Grass	<i>Andropogon gayanus</i>	A/C	Y
Neem	<i>Azadirachta indica</i>	B/C	-
Grader grass	<i>Themeda quadrivalvis</i>	B/C	Y
Snake weed	<i>Stachytarpheta spp.</i>	B/C	-
Devils Claw	<i>Martynia annua</i>	A/C	-

EcOz also liaised with the Department of Environment and Natural Resources (DENR) Weeds Management Branch to confirm the species listed in Table 3-1 and Table 3-2 include all the weeds for which surveys should be undertaken. The Weeds Management Branch agreed that the lists covered all weeds for which surveys should be conducted. They also advised that although both Parthenium (*Parthenium hysterophorus*) and Grader Grass (*Themeda quadrivalvis*) are a concern given certain characteristics, it was wrong time of the year to survey.

The Weeds Management Branch were also consulted on the survey approach. The general approach agreed upon was to walk all the VSP lines and the areas within the 500 m buffer surrounding the potential well sites. The Weeds Management Branch also suggested surveying surrounding areas as if there was weeds adjacent to the exploration program footprint, weed seeds could be present within the soil and disturbance may provide opportunity for establishment.

EcOz also met staff from the Weeds Management Branch on-site prior to surveys. During this inspection the lack of weeds and general intact condition of the landscape was noted.

### 3.2 Methods

A baseline weed survey was undertaken between the 8th – 11th August by a team of EcOz Environmental Consultants, all with experience in surveying weeds and vegetation in the Northern Territory.

Data layers including 5km VSP lines and survey boundaries, 500m buffer areas at Tanumbirini-2 and Tanumbirini-3, drainage lines, creeks, and aerial imagery, were used in the production of detailed survey maps for on-ground reference in the field. Field maps were transferred to AVENZA, which was enabled as a moving map display by using a handheld smartphone device.

The VSP lines were surveyed by walking each line (within 5 m buffer) and recording any weeds with a handheld GPS unit.

A grid, with cells of 100 m x 100 m was overlaid, on each of the 500 m buffer areas around the potential well sites. Surveyors searched for weeds within the 500 m buffer around Tanumbirini-2 by walking the area ensuring they passed through each of the 100 m x 100 m grids.

A similar process was applied to Tanumbirini-3, however, the vegetation within this buffer area was dense *Acacia shirleyi* and *Eucalyptus leucophloia* indicating likelihood of weed invasion was fairly low. A disused, partially overgrown access track was the only disturbance within the area. Surveys within this buffer did not

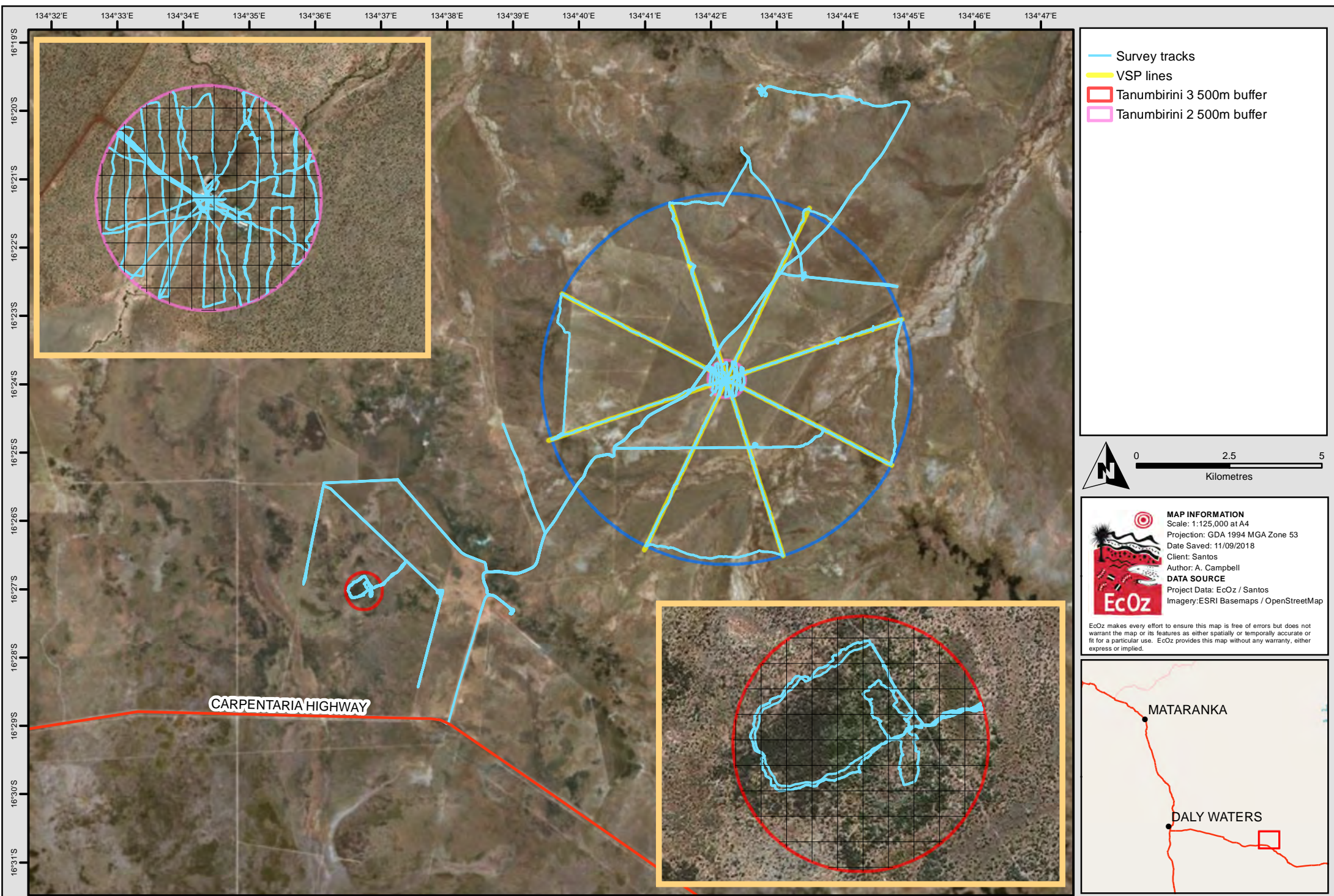
pass through each grid cell, however, the grid cells were used as a guide with surveyors ensuring the disturbed area was searched.

Weed species were recorded according to those outlined in the NT Weed Data Collection Manual (*Weed Management Branch NT 2015*) and include the following:

- Weed species name (using two letter initials)
- Patch size (m): 5, 20, 50, 100
- Density (%): 1 = absent  
2 = <1  
3 = 1 - 10  
4 = 11 - 50  
5 = >50
- Seed occurrence (seed present on plant): S

Likely station tracks used to access exploration areas were surveyed by vehicle. Tracks were driven slowly and where a weed species was seen, the vehicle was stopped and data recorded. Where large patches of a weed species (*Hypitys*) were recorded, the start and end of the patch was recorded and a general density estimate made. A number of fence-lines and stock watering points were searched for weeds. Fence-lines were searched similarly to access tracks, stock watering points were searched on foot and data recorded in the same manner as for VSP lines and buffer areas.

The Survey tracks are shown on Figure 3-1.



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**Figure 3-1. Map showing program footprint and survey tracks**



### 3.3 Results

The baseline weed survey recorded 48 occurrences of a total of five declared weed species. The number of occurrences of each weed species is shown in Table 3-3, the location of weed records is shown on Figure 3-3. The majority of weeds occurred along station tracks.

Hyptis was the most abundant weed recorded, with 35 records, and the broadest distribution. Hyptis was recorded primarily along access tracks and at watering points, but there were a few small patches of low density recorded along the VSP lines and within the Tanumbirini-2 buffer.

One patch of Rubber Bush was found in paddocks adjacent to an access track Figure 3-3. The patch was relatively dense in a disturbed area, and appear to extend into the paddock to the south west. Individuals in the patch were flowering and 4 plants were observed to have seed present. It is likely that seed is contained in the soil in the access track adjacent to the infestation. Although not declared at this location, it can cause significant environmental and financial damage. It is a declared weed south of the Carpentaria Highway – including in areas of EP161.

Surveyed patches of *Sida* sp. were only recorded at cattle watering points (Figure 3-3).

**Table 3-3. Declared weed species**

Common name	Scientific name	NT Class	No. of records	Seeded
Hyptis	<i>Hyptis suaveolens</i>	B and C	35	4 plants
Rubber Bush	<i>Calotropis procera</i>	B and C	7	4 plants
Sida sp	<i>Sida</i> sp	B and C	4	None
Sicklepod	<i>Senna obtusifolia</i>	B and C	1	None



Rubber Bush (*Calotropis procera*)

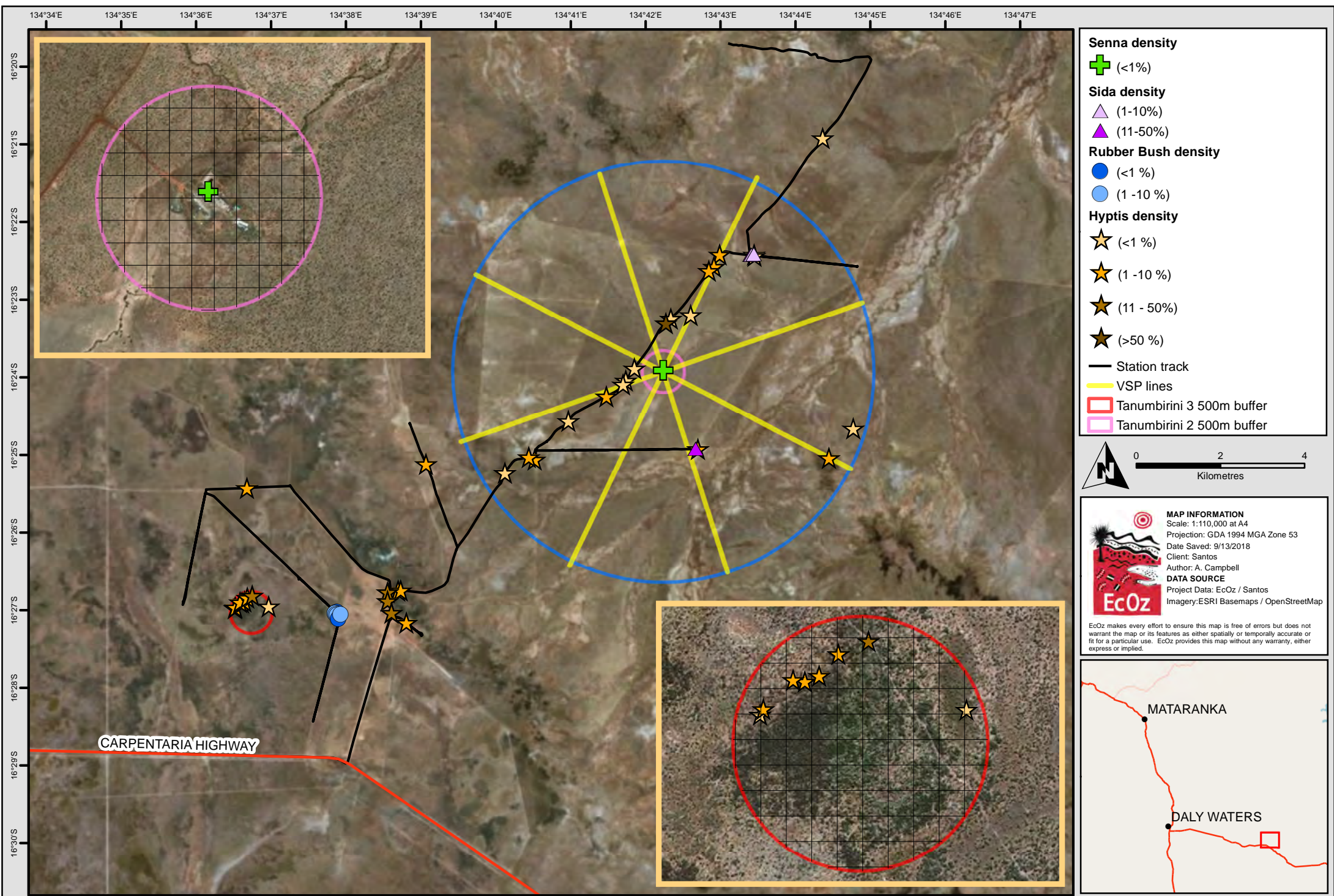


Rubber Bush (*Calotropis procera*)



**Figure 3-2. Photos of weeds identified during surveys**





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**Figure 3-3. Weed records within the Exploration program footprint and surrounds**

## 4 THREATENED SPECIES HABITAT

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This section provides context for and describes the threatened species habitat surveys undertaken within the survey footprint.

### 4.1 Background

The completed desktop study (EcOz 2017) determined that Gouldian Finch (*Erythrura gouldiae*) had a medium chance of occurring with the survey area (which included both the VSP lines and both potential well sites). Gouldian Finch is listed as endangered under both the Environment Protection and Biodiversity Conservation Act (EPBC Act) (1999) and the Territory parks and Wildlife Conservation Act (TPWC Act).

The Gouldian Finch has specific habitat requirements. In the late wet season and entire dry season (February to October) the species occurs in rocky hills that support *Eucalyptus leucophloia* (commonly referred to as Snappy Gum). *Eucalyptus leucophloia* is one of these preferred nesting species. Nest sites are between two and four kilometres from small permanent waterholes or springs (O'Malley et al. 2006). Gouldian Finch feed on annual spear grasses and native sorghum (i.e. *Sorghum* species) during this period.

The field inspections as part of the previous study (EcOz 2017) identified a number of sites where *E. leucophloia* was present on hilled areas within exploration permit. The understorey species at these sites consisted of hummock, tussock or a mixture of hummock/tussock grass species. In a number of areas, the habitat was considered to be long unburnt (there were large spinifex hummocks) and there were considerable hollows which, through preliminary assessment, appeared to be suitable nesting locations.

Although *E. leucophloia* was present within the broad survey area, the inspections did not specifically cover the exploration program footprint – and thus could not determine whether suitable habitat for Gouldian Finch was present within these areas. To address this, the previous report recommended that if more extensive works are proposed to be undertaken, Santos should assess the risk and impact to Gouldian Finch. Particularly:

- Prior to more intensive works being undertaken, it is recommended that further assessment of habitat for Gouldian Finch and potential impact to this species be undertaken. This would include desktop assessment and on-ground studies and would be assessed in relation to a project footprint.

The first step in determining the potential impact is to determine whether habitat for the species is present within the program footprint. To determine this field surveys were undertaken within the exploration program footprint. Targeted surveys for the species would only be undertaken if there was suitable habitat present within the program footprint.

### 4.2 Method

To determine the presence of suitable habitat for Gouldian Finch within the program footprint the presence and habitat characteristics of Snappy Gum (*E. leucophloia*) woodland within the program footprint was determined.

Surveyors walked the VSP lines and marked any occurrence of *E. leucophloia* within the exploration program footprint. At each patch of *E. leucophloia* the following information was recorded:

- Tree density
- Tree heights (m)
- Type of trunk (single or 'Mallee')
- Hollow heights (m)
- Number of hollow > 25 mm



- General hollow angle
- Understorey vegetation description
- Fire impact

The habitat suitability of each patch of *E. leucophloia* for Gouldian Finch was categorised based on these characteristics.

Within the 500 m buffer around Tanumbirini-3, two transects were walked (each 200 m long) and every *E. leucophloia* 10 m either side of the transect was recorded. At a sub-set of these trees, the number of hollows in living tissue and were between 2.5 cm and 10 cm in diameter were recorded (these were considered to be suitable nesting hollows for Gouldian Finch).

Whilst undertaking all surveys within and around the exploration program footprint, surveyors compiled a bird list – looking in particular for threatened species including Gouldian Finch. Particular note of Long-tailed Finches (*Poephila acuticauda*) was also made, as this species is known to form mixed flocks the Gouldian Finch (TSSC 2016).

## 4.3 Results

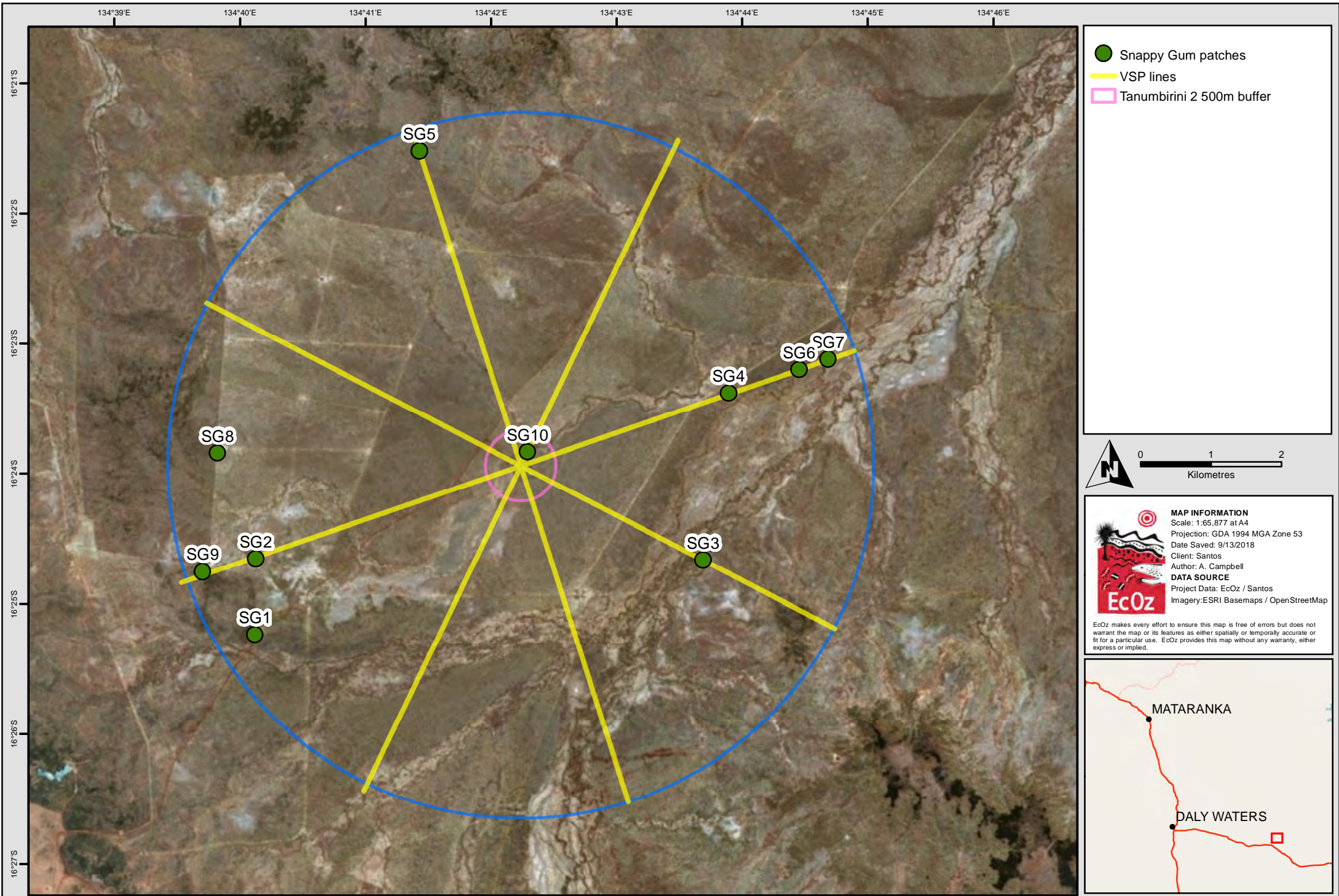
Given the difference in vegetation and the likely impact depending on the exploration activities, the exploration program footprint has been considered in two parts: VSP lines and Tanumbirini-2, and Tanumbirini-3

### 4.3.1 VSP lines & Tanumbirini-2

In general, the VSP lines passed through few snappy gum patches; there were 8 patches of *E. leucophloia* along the VSP lines including a small patch of *E. leucophloia* within the 500 m buffer of Tanumbirini-2. There were two patches of *E. leucophloia* with 5 km of Tanumbirini-2 but outside the Exploration Program Footprint. The locations of some *E. Leucophloia* patches are shown in Figure 4-1.

The characteristics of 6 patches and the derived habitat suitability is shown in Table 4-1 (these patches were representative of the 9 crossed by the VSP lines). There were hollows present and the trees were often relatively large for the species. Although unconfirmed, it is likely that the patches are within 4 km of water given the number and location of stock watering points in addition to the small residual pools which were present within the ephemeral drainages. As such, although it is unknown whether these patches are used by nesting Gouldian Finches, they do present habitat that could be used by the species.

The few patches of Snappy Gum represented typical open-woodland to woodland vegetation communities. Densities of Snappy Gums were such that VSP vehicles could pass through these areas without removing trees. In the event that a tree does need to be removed for VSP activities, it is likely that only a single tree will be affected.



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**Figure 4-1. Location of *E. leucophloia* patches along VSP lines**

Table 4-1. *E. leucophloia* habitat characteristics

Patch	Tree density (#/ha)	Tree heights (m)	Trunk type	Hollows per tree	Hollow heights (m)	Number hollows > 25 mm	General hollow angle	Vegetation	Fire impact	Suitability
SG8	4	8	Mallee	5	2 - 5	2*	45°	Open woodland of <i>Hakea sp</i> and <i>Acacia sp</i> over Tussock grassland	Nil	Low
SG9	7	8	Mixed	1 – 3	2 - 5	5*	90	Sparse <i>Acacia</i> spp. shrubland over Tussock grassland	Nil	Low
SG2	10	6	Mallee	3	1 – 3	1*	40°	Sparse mid-story of <i>Hakea</i> spp. over Tussock grassland	-	Low
SG10	4	6	Mallee	0	N/A	N/A	N/A	<i>Themeda triandra</i> and <i>Heteropogon contortus</i>	Nil	Low
SG4	8	6 -7	Mixed	0	N/A	N/A	N/A	<i>Themeda triandra</i> and <i>Heteropogon contortus</i>	Nil	Low
SG5	40	6	Single	3 – 4	2.5 – 5m	50% of hollows	90°	<i>Acacia</i> sp and <i>Grevillea</i> sp. over Tussock grassland, some <i>Themeda triandra</i>	Nil	High

\* - total number of hollows (indicating percentage hollows > 25 mm is low)



### 4.3.2 Tanumbirini-3

The vegetation community within the 500 m buffer around Tanumbirini-3 consists of Lancewood (*Acacia shirleyi*), Bullwaddy (*Macropteranthes kekwickii*) and Snappy Gum (*Eucalyptus leucophloia*). The vegetation is dense (forest community) where there are stands of Lancewood and Bullwaddy which was interspersed by small open patches. Snappy Gum occurred at a relatively consistent density throughout the area. Understorey vegetation was tussock grasses.

Figure 4-3 shows photos of the vegetation within the Tanumbirini-3 buffer.







**Figure 4-2. Photos showing vegetation within the Tanumbirini-3 buffer**

Field observations indicated that within the buffer area there is a distinct area of homogenous vegetation containing Snappy Gum (Snappy Gum area); this is supported by the available satellite imagery. Figure 4-3 shows the bounds of this vegetation area which is approximately 30 ha of the 78 ha buffer area. Snappy Gum will only occur at very low density in other areas of the buffer.

The survey area within the Tanumbirini-3 buffer was 8,000 m<sup>2</sup>, which equated to 9 % of the Snappy Gum area. Within the survey area there were 97 *E. leucophloia* trees at a density of 121 per hectare. Using the number of *E. leucophloia* in the survey areas indicates there are approximately 3,630 *E. leucophloia* in the Snappy Gum area, and thus the buffer area.

The *E. leucophloia* trees that were surveyed showed a high degree of fire impact; many of the trees were heavily fire scared in both the trunk and branches. Although not recorded many of the trees exhibited a 'Mallee' growth form – multiple smaller trunks rather than a single (or few) larger trunk. Although this in itself does not preclude the formation of suitable nesting hollows, the resulting smaller stems seem to be less likely to contain hollows. Figure 4-3 shows the location of *E. leucophloia* trees within the survey area.

Hollow counts were conducted at 43 of the 97 *E. leucophloia* trees identified. Eight of the 43 *E. leucophloia* trees contained suitable hollows for Gouldian Finch nesting, with a total of 16 suitable hollows in the 43 trees. Hollow numbers for each tree are shown in Table 4-2.

Given the low number of hollows present within the *E. leucophloia* trees at this site, it does not present optimal habitat for the Gouldian Finch and it is unlikely that the species utilises this area for nesting.

**Table 4-2. Hollow counts for *E. leucophloia* within Tanumbirini-3 buffer**

Tree waypoint	No. hollows	Tree waypoint	No. hollows	Tree waypoint	No. hollows
139	0	154	0	168	0
140	0	155	0	169	0
141	1	156	0	170	0
142	0	157	0	171	2
143	0	158	0	172	0
144	3	159	0	173	0
145	0	160	0	174	0
146	0	161	0	175	0
147	0	162	0	176	0
148	0	163	0	177	0
149	1	164	0	178	0
150	1	165	0	179	1
151	0	166	0	214	3
152	0	167	0	215	4
153	0				

### 4.3.3 Species records

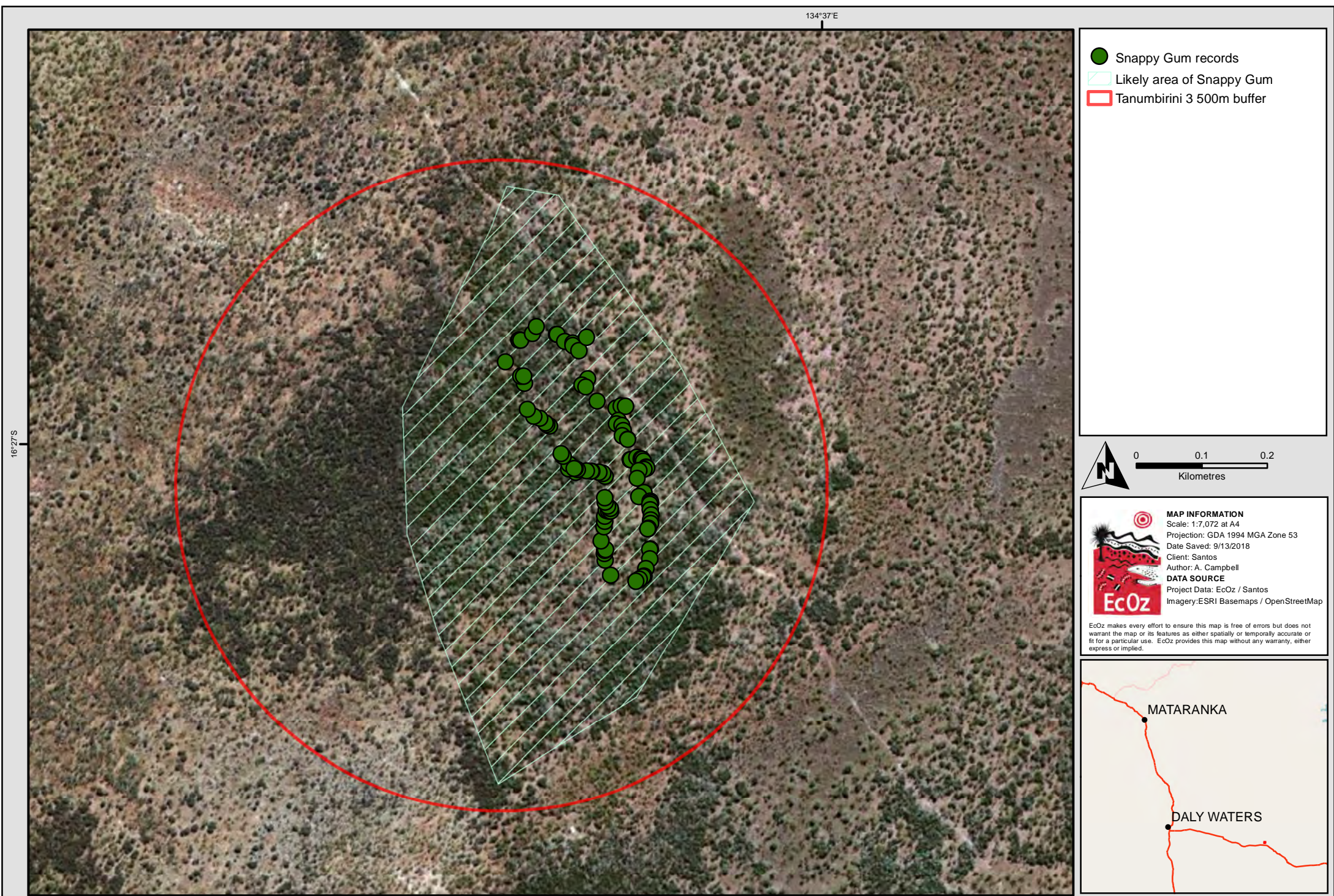
No threatened species were observed during surveys. Long-tailed Finches were observed at a number of locations within the exploration program footprint, and were consistently found at stock watering points.

Anecdotal evidence suggests that Gouldian Finches do, or at least have occurred on Tanumbirini Station (and within EP161), however, they are more likely to occur in the northern sections – outside the 2018 Exploration Program Footprint.

Avian species list is provided below.

Double-barred Finch	Brown Honeyeater	Black Falcon
Peaceful Dove	Nankeen Night Heron	Australian Pratincole
Black-faced Wood-swallow	Straw-necked Ibis	Red-tailed Black-Cockatoo
Nankeen Kestrel	Great Bowerbird	Galah
Black Kite	Darter	Zebra Finch
Willy Wagtail	Great Egret	Cattle Egret
Whistling Kite	Mistletoebird	Black-faced Cuckoo-shrike
Diamond Dove	Yellow-tinted honeyeater	Red-backed Fairy-wren
Long-tailed Finch	Plumed Whistling Duck	Apostlebird
Royal Spoonbill	Crested Pigeon	Grey-crowned Babbler
Great Cormorant	Wedge-tailed Eagle	Common Bronzewing
Masked Cuckoo Shrike	Masked Finch	Little Wood-swallow
White Browed Wood-swallow	Black-tailed Tree-creeper	Budgerigar
Cockatiel	White bellied Cuckoo Shrike	Brown falcon





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Figure 4-3. *E. leucophloia* trees within Tunambirini-3 survey area



## 5 SENSITIVE VEGETATION

Significant or sensitive vegetation communities are described in the *NT Land Clearing Guidelines* (NRETAS 2010). They are vegetation communities that are distinct and limited in extent or support important ecological values and include rainforest, vine thicket, closed forest or riparian vegetation, mangroves, monsoon vines forest, sand-sheet heath and vegetation containing large trees with hollows suitable for fauna.

Within the exploration program footprint, riparian vegetation is the most likely sensitive vegetation community to occur. Riparian vegetation occurs along freshwater waterways (ephemeral or permanent). It is a distinct, closed forest community that creates suitable conditions for a range of species (terrestrial and aquatic) by providing shade (DLRM 2013). It covers a relatively small land area and provides unique habitat features and dry season refuge for a range of native fauna species (DLRM 2013).

Previous site visits determined that there was riparian vegetation which could be classified as a closed forest community within the broader area, however, no observations were made regarding vegetation along the VSP lines. Examples of vegetation along watercourses observed during previous site visits are shown in Figure 5-1.



Figure 5-1. Riparian vegetation within the broader area



## 5.1 Method

Satellite imagery was used to determine potential areas of sensitive vegetation along the VSP lines. These areas were focussed around the watercourses crossed by the VSP lines. The location of areas within the program footprint which may support sensitive vegetation are shown in

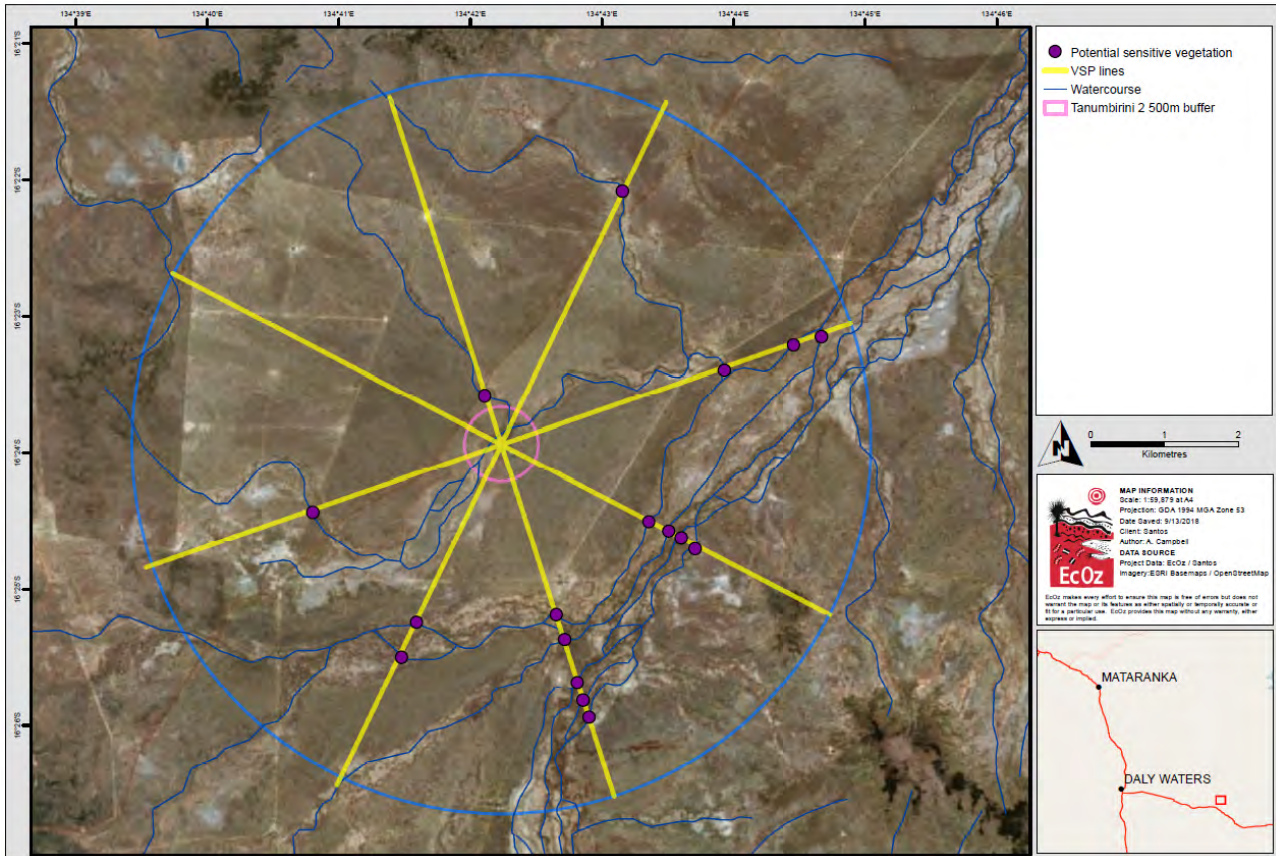


Figure 5-3.

Surveyors walked each of the VSP lines and made observations of the vegetation at each watercourse crossing. Photos of the vegetation and watercourse were taken. A formal vegetation assessment including height of the tallest stratum and percentage foliage cover of the tallest plant layer was not made (this would be required to determine structural form of the vegetation – forest community or otherwise). This was considered appropriate given both the type of vegetation encountered and that potential impacts from VSP are minimal.

## 5.2 Results

The vegetation intersected by the VSP lines at watercourse crossings comprised primarily a narrow strip of *Eucalyptus camaldulensis* in the upper-storey. Canopy cover along the riparian strip is higher than the surrounding woodland and open plains, however, visual inspection did not indicate that canopy foliage cover was sufficiently dense for the vegetation to be classified as a forest community. Height of upper-storey of riparian vegetation was between 5 and 10 metres. There was limited mid-storey vegetation at any of the watercourse crossing sites. Ground cover comprised tussock grasses consistent with the surrounding land forms. Vegetation at a number of drainage lines did not show any distinction between that of the surrounding landscape. Photos of vegetation at locations where the VSP lines cross watercourses are shown in Figure 5-2.

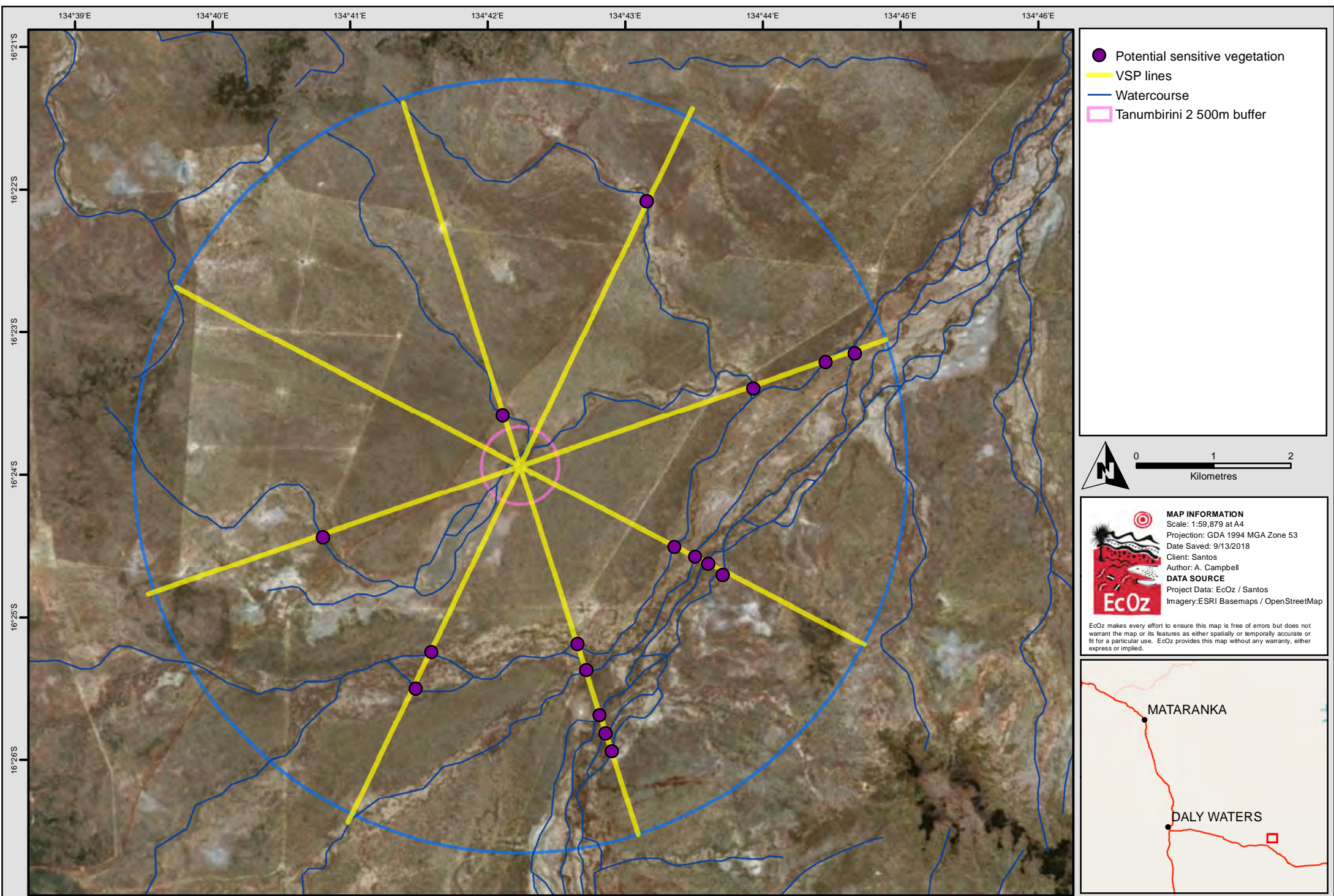
The vegetation was sufficiently sparse that vehicles involved in VSP should be able to pass through the riparian strip without impacting the vegetation.





**Figure 5-2. Photos of riparian vegetation at VSP - watercourse intersections**





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**Figure 5-3. Map showing sites of potential sensitive vegetation within Exploration Program Footprint**

## 6 CONCLUSION & RECOMMENDATIONS

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Surveys within the 2018 Exploration Program Footprint were completed for:

- Listed weed species
- Threatened species habitat and incidental species observations
- Sensitive vegetation

Weed diversity within the footprint is low, with only five weed species recorded. Weeds are also at low densities except for Hyptis, which occurs both at high densities and frequently throughout the program footprint. There is one patch of Rubber Bush beside an access track near Tanumbirini-3. The majority of weeds were recorded along access tracks or at stock watering points. Although it is likely that there is Hyptis seed within the station access tracks, the species is currently wide spread along the access tracks likely to be used in exploration activities.

Tanumbirini-2 and the VSP lines cross nine patches of Snappy Gum. The Snappy Gum patches along the VSP lines, although relatively small should be considered as potential Gouldian Finch habitat. The density of the trees within the patches was such that VSP exploration activities should be able to avoid impacting trees. The habitat value of Snappy Gum within the Tanumbirini-3 buffer to Gouldian Finches was considered low and, as such, clearing of this area is unlikely to impact the species. Best practice environmental management of minimising the disturbance to the smallest extent required should be employed as routine, however, it is not considered that specific management controls be undertaken.

The vegetation along the watercourses, although denser than surrounding communities, is not considered to be a riparian forest community and, as such, not sensitive vegetation. The vegetation is sparse enough the vehicles involved in VSP should be able to avoid impact to vegetation along drainage lines. Minimising the disturbance to vegetation along the drainage lines will help maintain stability of the watercourses, reduce sedimentation and retain wildlife habitat.

EcOz makes the following recommendations for the 2018 exploration activities:

### Weeds

- All vehicles involved in exploration activities should be certified weed free prior to entering Tanumbirini Station.
- Care should be taken when undertaking activities near the identified patch of Rubber Bush. Although not listed at this particular location, the species has potential to spread and cause significant impact to both environmental values and station function. Consideration should be given to undertaking management (eradication/control) of this Rubber Bush patch if works are to be undertaken at Tanumbirini-3.
- Planning for future exploration (and production activities) should include completion of weed surveys. Depending on the nature of the activity this could be surveys of the project footprint, or holistic surveys of the larger exploration area. Consideration should be given to the time of year when the surveys are undertaken (to maximise probability of detection) and the methods through which the surveys are undertaken (in consultation with the weeds branch).

### Snappy Gum

- Avoid removal of Snappy Gum trees within the patches along the VSP lines. This should be achievable through the design of the VSP (i.e. vehicles weave through trees) without specific management controls. If significant numbers of trees are to be removed, consideration should be given to have environmental staff on site to identify ways to minimise impact to Snappy Gums.

## 7 REFERENCES

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EcOz Pty Ltd.  
ABN 81 143 989 039

Winlow House, 3rd Floor  
75 Woods Street  
Darwin NT 0800

GPO Box 381,  
Darwin NT 0800

T: +61 8 8981 1100  
F: +61 8 8981 1102  
E: [ecoz@ecoz.com.au](mailto:ecoz@ecoz.com.au)  
[www.ecoz.com.au](http://www.ecoz.com.au)



## **Appendix 4 Land Access Compensation Agreement Revision**

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## **Appendix 5: Tanumbirini Stakeholder Engagement Records**

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